Evaluation of the Texas Technology Immersion Pilot

An Analysis of the Baseline Conditions and First-Year Implementation of Technology Immersion in Middle School

December 2006

Prepared for
Texas Education Agency

Prepared by
Texas Center for Educational Research

TCER
Texas Center for Educational Research

Texas Center for Educational Research
P.O. Box 679002
Austin, Texas 78767-9002
800-580-TCER (8237)
512-467-3632 512-467-3658 (fax)
www.tcer.org

TCER
Texas Center for Educational Research

EVALUATION OF THE TEXAS TECHNOLOGY IMMERSION PILOT

An Analysis of Baseline Conditions and First-Year Implementation of Technology Immersion in Middle Schools

December 2006

Prepared for
Texas Education Agency

Prepared by
Texas Center for Educational Research

Credits

Texas Center for Educational Research

The Texas Center for Educational Research (TCER) conducts and communicates nonpartisan research on education issues to serve as an independent resource for those who make, influence, or implement education policy in Texas. A 15-member board of trustees governs the research center, including appointments from the Texas Association of School Boards, Texas Association of School Administrators, and State Board of Education.

For additional information about TCER research, please contact:

Kelly S. Shapley, Director
Texas Center for Educational Research
12007 Research Blvd.
P.O. Box 679002
Austin, Texas 78767-9002
Phone: 512-467-3632 or 800-580-8237
Fax: 512-467-3658

Reports are available at www.tcer.org and www.etxtip.info

Contributing Authors

Texas Center for Educational Research
Kelly Shapley, Ph.D.
Daniel Sheehan, Ed.D.
Keith Sturges, M.A.A.
Fanny Caranikas-Walker, Ph.D.
Briana Huntsberger, M.P.Aff.
Catherine Maloney, Ph.D.

Prepared for

Texas Education Agency
1701 N. Congress Avenue
Austin, Texas 78701-1494
Phone: 512-463-9734

Research Funded by

U.S. Department of Education

Table of Contents

Executive Summary

The Texas Education Agency (TEA) used Title II, Part D monies to fund a wireless learning environment for high-need middle schools through the Technology Immersion Pilot (TIP). A concurrent research project funded by a federal Evaluating State Education Technology Programs grant is scientifically evaluating whether student achievement improves over time as a result of exposure to technology immersion. Technology immersion encompasses multiple components, including a laptop computer for every middle school student and teacher, wireless access throughout the campus, online curricular and assessment resources, professional development and ongoing pedagogical support for curricular integration of technology resources, and technical support to maintain an immersed campus.

The study of technology immersion employs a quasi-experimental research design with middle schools assigned to either treatment or control groups (22 schools in each). While the overarching purpose of the study is to scientifically test the effectiveness of technology immersion in increasing middle school students' achievement in core academic subjects, the evaluation also aims to examine the relationships that exist among contextual conditions, technology immersion, intervening factors, and student achievement. Data gathered through site visits to all participating middle school campuses in fall 2004 and spring 2005 allowed an in-depth examination of campus conditions, school and classroom activities, and educational roles and processes through interviews with key personnel, focus groups with teachers and students, inventories of technology resources, and reviews of documents. Major findings from the first year are summarized below.

Baseline Characteristics of Middle Schools

Fall site visits allowed researchers to gather data on existing conditions to establish the comparability of treatment and control campuses prior to immersion. We documented the nature of technology access, technical and pedagogical support, teachers' prior participation in technology-related professional development, and technology use by teachers and their students.

Technology Access. Technology access was meager at both treatment and control campuses in fall 2004. Teachers, on average, had few computers in their classrooms (less than three) and few technology resources, such as printers and LCD projects. Computers were typically located in computer labs, technology applications classrooms, or libraries, and scheduling difficulties, according to teachers, restricted access to those locations. Technical problems caused by outdated and inoperable equipment and campus network and Internet troubles also thwarted teachers' technology use.

Technical and Pedagogical Support. Although the extent and configuration of technical and pedagogical support varied across treatment and control campuses, most had general technical assistance and at least some support for curricular integration. Both treatment and control campuses faced similar technical support challenges, and ongoing technology problems created barriers to access and use.

Professional Development. Technology-related professional development was widely available to most teachers, but the training content generally focused on computer literacy rather than curricular integration. Teachers at treatment and control campuses experienced similar technology professional development needs, barriers to participation, and interest in one-on-one assistance. Teachers wanted ongoing personal support for curricular integration from trainers with practical classroom experience.

Teacher and Student Technology Use. In fall 2004, teachers seldom incorporated technology into their lessons because they had few computers in the classroom. Many teachers, however, routinely used technology for administrative purposes such as keeping grades and reporting attendance. Students at both treatment and control campuses had similar technology access and used technology in comparable ways (e.g., educational programs, Internet-based research, and electronic presentations).

Initial Steps toward Technology Immersion

Considering that activities undertaken by districts and campuses in the early phases of a school reform initiative may influence subsequent progress toward institutional change, we asked educators at immersion campuses to describe their early efforts.

Staff Involvement in Decision Making. The absence of broad-based participation in decision making threatened buy-in for TIP projects. In most cases, the timing of competitive grants diminished possibilities for staff participation in the application process. At about a third of middle schools, principals were not involved in the grant application, and at most campuses, teachers were not consulted about the decision to apply for TIP grants.

Vendors, Policies, and Funding. Because technology immersion requires the coordination of the delivery of hardware, software, and sustained professional development, initial progress toward immersion hinged on establishing supportive and dependable relationships with vendors. Yet early in the project, educators' perceived levels of support from vendors varied from campus to campus. Additionally, almost all campus principals in fall realized that they had to address policy and funding issues associated with technology immersion, but limited time for planning meant that leaders generally had to generate solutions as needs arose during project initiation.

Readiness for Immersion

Many campuses in fall were unprepared to undertake a whole-school technology initiative. Lack of readiness was evidenced notably in school personnel's capacity, proficiency, attitudes, and understanding of technology immersion.

Capacity of Technical Staff. A shortage of well trained and capable staff jeopardized prospects for adequate technical and pedagogical support at many campuses. Technology coordinators, especially at small campuses, believed that technical staff was already spread thin and that, without additional personnel, adequate support for immersion would be difficult.

Teacher Readiness. Teachers' limited technology proficiency in fall was viewed as a potential hindrance to technology immersion. Many teachers lacked basic troubleshooting skills and had even less ability and experience with technology integration. Additionally, teachers' commitment to technology immersion was tempered by their anxiety about the increased work load as well as their uncertainty about the immersion concept. Teachers' enthusiasm for immersion most often stemmed from their perceived benefits for students.

First-Year Implementation of Technology Immersion

Between March and May 2005, researchers conducted follow-up site visits to each of the treatment and control campuses. Site visits to control campuses verified that little had changed since fall visits. Technology access and use remained virtually unchanged and campuses continued to pursue their previously declared educational missions.

Implementation of Immersion Components. At treatment campuses, researchers assessed the implementation of grant-specified components of technology immersion (i.e., robust access, technical and pedagogical support, professional development, and resource utilization). Overall findings showed that none of the campuses had fully implemented the immersion components in the first year.

Robust Access to Technology. Due to delays in laptop rollout, the amount of time students had their laptops varied by campus (from 72 to 138 days), with many students having less than four months of laptop use. Moreover, some campuses restricted students' access to their laptops outside of school. Older middle school buildings also caused access problems because many did not support the infrastructure demands of technology immersion. Technology access also was affected by ongoing software, Internet, and hardware maintenance issues.

Technical and Pedagogical Support. Many districts and campuses had difficulty meeting the technical demands of immersion. Even though the grant required each campus to provide dedicated technical support, the level of support varied widely during first-year implementation. Pressing technical requirements also diminished staff capacity to provide campus-based pedagogical support. Thus, teachers who generally failed to receive necessary in-class support for technology integration relied on each other for instructional support.

Professional Development. On both Dell and Apple campuses, first-year professional development emphasized knowledge of immersion package tools and their classroom use. Both Apple and Dell provided some in-class support for integration, although the characteristics of classroom training differed. Despite differences in the professional development models, the outcomes were similar. Professional development increased teacher comfort with technology and led to some changes in classroom practice. A number of teachers, however, had difficulty retaining content or were indifferent to changed practice. After initial teacher resistance, most principals in spring believed teachers' attitudes improved as they became more familiar with technology immersion. Still, gaining teacher buy-in remained a central challenge of implementing immersion at some campuses.

Resource Utilization. Most teachers reported limited use of TIP package resources in the first year. Some teachers said they lacked the skills and training to use the instructional and learning resources, while others cited a lack of time or frustrations when resources did not work as expected. As a whole, the infusion of an array of resources within a short time span was overwhelming for many teachers.

Implementation Supports for Immersion. Information collected during the first year revealed that campus and district leaders played a critical role in the implementation of technology immersion. Likewise, parent and community buy-in was essential for successful implementation.

District and Campus Leadership. District administrators' roles and levels of involvement with immersion campuses varied widely, and personnel turnover was one factor that affected district leadership. A synthesis of comments about campus leadership indicated that principals demonstrated effective leadership for immersion by scheduling planning time, communicating expectations, modeling technology use, marshalling resources, establishing and enforcing policies, and encouraging teacher efforts.

Parent and Community Support. The level of parent support varied across campuses. And, while most parents viewed students' laptop access as a welcome learning opportunity, some feared financial repercussions or worried about inappropriate use.

Progress toward Classroom Immersion. As part of focus groups, teachers and students described the nature and extent of their technology use during the first year. Nearly all of the teachers reported that they integrated technology into their lessons at least some of the time—however, laptop use varied across schools, classrooms, and subject areas. In English language arts and reading classes, students' laptops most commonly provided a tool for acquiring basic factual knowledge and creating written products. In science classrooms, laptops most often provided a mechanism to conduct topical research on the Internet. Similarly, in social studies classes, laptops most often served as a tool for topical research on the Internet, writing, and note-taking. Math teachers struggled to find ways to integrate technology into their curriculum. As a whole, teachers were challenged in the first year by insufficient guidance for lesson development, minimal in-class modeling and coaching, and a lack of time to meet the increased demands of technology immersion.

Effects of Technology Immersion

Schools. The TIP grants fostered the infusion of new technologies that moved middle-school campuses toward expectations for the 21st century. New resources often were viewed by educators as a mechanism for changing teaching and learning to better meet the needs of today's students who are accustomed to more interactive, digital experiences. Laptops also were believed to provide a means for students to acquire knowledge and skills essential for gaining admission to post-secondary educational opportunities and seeking future employment. Many also saw TIP grants as a way of leveling the playing field for students from low socio-economic backgrounds. With the provision of laptops came a sense of equity as *all* students now had access to the same resources. In the words of a sixth grader, "Now everybody knows how to use the computer." Still, the introduction of laptops challenged educators with a variety of unanticipated discipline issues and spurred the implementation of new policies and consequences for laptop infractions.

Teachers. Teachers across campuses thought technology immersion required an extraordinary commitment of time and effort. Even though learning to use new resources and to integrate laptops into instruction had been difficult for many who began the project with minimal skills, with time teachers gained confidence and increased their proficiency and comfort with technology. Across immersion campuses, teachers said they had changed their approach to classroom instruction, with the most prevalent change involving the use of online resources for student-directed research projects. The presence of laptops also required teachers, sometimes reluctantly, to change classroom management strategies.

Students. Despite some disciplinary issues, technology immersion appeared to have a number of benefits for students. Foremost, administrators, teachers, and students cited positive effects of immersion on students' engagement in school and learning and their technology proficiency. Immersion appeared to provide a particular advantage for special student populations (e.g., English language learners, special education students, and students with habitual discipline problems). According to educators and students, immersion also gave students greater access to information not found in textbooks, new resources and learning tools that reshaped their approaches to class work and improved study habits, and opportunities to demonstrate greater self-responsibility and self-regulation of their learning and behavior. Although many students thought laptops made them better learners and improved their academic performance, most teachers were reluctant to link immersion to student achievement.

Lessons Learned in the First Year

Findings from the first year provide direction for the refinement of the technology immersion model as well as information for other schools planning for technology immersion. Lessons to follow address leadership and planning, technical support, professional development, classroom immersion, and sustainability and expansion.

Leadership and Planning

- Involve district and campus leaders, teachers, and parents in the decision to become a technology immersion campus.
- Build strong leadership for immersion.
- Allow extended time to plan for immersion.
- Establish supportive and dependable relationships with vendor partners.
- Devise a plan for dealing with complex logistical arrangements.
- Ensure laptop and Internet security.
- Establish well defined and understood policies and practices relative to student responsibility and appropriate use, and parent oversight.
- Budget for additional funds beyond grant awards.

Technical Support

- Build a healthy infrastructure for wireless technology prior to immersion.
- Hire campus-based technical support for immersion, and ensure that staff members have dedicated time for their assigned duties.

Professional Development

- Provide a well defined and consistent model for professional development.
- Address both knowledge of immersion resources and classroom integration.
- Provide distributed training with time for classroom implementation.
- Explore ways to address professional development scheduling challenges.
- Provide teachers with time, guidance, and support for change.

Classroom Immersion

- Recognize that teachers in the initial stages of immersion will generally use laptops and digital resources to enhance their existing instructional practices.
- Assess teachers' existing technology knowledge and skills and plan accordingly.
- Consider a gradual approach to the introduction of instructional and assessment resources.

Sustainability and Expansion

- Plan for continuation as part of the decision to become an immersion district or campus.
- Consider how immersion may need to be expanded to other schools and students.

1. Introduction

The Technology Immersion Pilot (TIP) sets forth a vision for technology immersion in Texas public schools that links ubiquitous access to technology with student achievement. The Texas Education Agency (TEA) directed nearly $14 million in federal Title II, Part D monies toward funding a wireless learning environment for high-need middle schools through a competitive grant process. A concurrent research project funded by a federal Evaluating State Educational Technology Programs grant is evaluating whether student achievement improves over time as a result of exposure to technology immersion. The Texas Center for Educational Research (TCER)—a non-profit research organization in Austin—is the TEA's primary partner in this landmark effort.

The overarching purpose of the study is to conduct a scientifically based evaluation at the state level to test the effectiveness of technology immersion in increasing middle school students' achievement in core academic subjects as measured by the Texas Assessment of Knowledge and Skills (TAKS). The evaluation also will examine the relationships that exist among contextual conditions, technology immersion, intervening factors (school, teacher, and student), and student achievement. Technology immersion encompasses multiple components, including a laptop computer for every middle school student and teacher, wireless access throughout the campus, online curricular and assessment resources, professional development and ongoing pedagogical support for curricular integration of technology resources, and technical support to maintain an immersed campus.

Study Questions

In the quasi-experimental research design, 44 middle schools were assigned to either treatment or control groups, with 22 schools in each. Researchers have posed six main research questions:

- What are the characteristics of participating schools?
- How is technology immersion implemented?
- What is the effect of technology immersion on schools?
- What is the effect of technology immersion on teachers and teaching?
- What is the effect of technology immersion on students and learning? and
- Does technology immersion impact student achievement?

This report concentrates on information gathered during site visits to all participating middle school campuses in fall 2004 and spring 2005. Site visits provided an in-depth look at middle schools through interviews with key personnel, focus groups with teachers and students, and building "walkthroughs" to survey technology resources.

During fall 2004 site visits, researchers gathered baseline data on existing conditions at both treatment and control campuses. Additionally, for TIP grant recipients, researchers collected information on initial efforts of districts and campuses to implement technology immersion at the 22 treatment sites (i.e., wireless laptop access for teachers and students, technical and pedagogical support, professional development, and curricular resources). Thus, findings from fall site visits address the study's first two research questions:

- What are the characteristics of participating schools, and
- How was the technology immersion pilot initiated?

For the first question, the research team identified technology resources and support and examined patterns of technology access and use prior to immersion. The collection of baseline data allowed the identification of factors at both treatment and control schools that might influence the study's outcomes. For immersion campuses, researchers also described efforts undertaken by each district and campus to initiate their TIP grant.

In spring 2005, researchers made follow-up site visits to the 44 middle schools. During those visits, we gathered extensive information at the immersion middle schools on first-year TIP implementation, and attempted to identify changes or effects that might have occurred over the course of the school year. Researchers also sought to identify variations in program implementation that might affect the study's outcomes. At control campuses, researchers sought to identify and describe any changes that had occurred during the school year, especially in relation to school and classroom technology access and the use of technology to support student learning. It was also of interest to identify other educational initiatives implemented during the school year that might influence the study's outcomes. Thus, findings from spring 2005 site visits addressed these research questions:

- To what extent was technology immersion implemented in the first year, and
- What was the effect of technology immersion on schools, teachers and teaching, and students and learning?

Organization of the Report

Report sections are organized around findings from site visits conducted during the 2004-05 school year and address the study's research questions.

- *Section 1, Introduction,* provides background on the TIP project and presents the purpose for the study and the research questions addressed.
- *Section 2, Methodology,* presents information on the evaluation design, characteristics of treatment and control schools, the study's theoretical framework, data collection methods, and data analysis procedures.
- *Section 3, Baseline Characteristics of Participating Sites,* describes patterns of technology access and use prior to the technology pilot as a way to establish the comparability of treatment and control schools.
- *Section 4, Technology Immersion Pilot—Initiation Phase,* describes technology immersion packages provided by the three vendor leaders (Apple, Dell, and Region 1 Education Service Center), offers an historical analysis of grant development, and describes activities that immediately followed grant-award notification.
- *Section 5, Technology Immersion Pilot—First-Year Implementation,* includes information on TIP project implementation and progress made in the first year, including classroom uses of technology for teaching and learning and perceived effects of immersion on schools, teachers, and students.
- *Section 6, Summary and Conclusions,* provides major findings from the first year.
- *Section 7, Technology Immersion—Lessons Learned in the First Year* draws from first-year experiences to identify lessons learned in implementing one-to-one technology and suggests implications for immersion schools and others considering the implementation of ubiquitous technology in schools.

2. Methodology

Evaluation Design

The evaluation design is quasi-experimental with carefully matched treatment and comparison groups. The design aims to approximate a randomly assigned control group by matching immersion schools with non-immersion schools possessing similar pre-program characteristics. For this study, interested districts and associated middle schools responded to a Request for Application (RFA) offered by the Texas Education Agency (TEA) in spring 2004 to become technology immersion schools. Applicants to become Technology Immersion Pilot (TIP) sites had to meet eligibility requirements for Title II, Part D funds (i.e., high-need due to children from families with incomes below the poverty line, schools identified for improvement, or schools with substantial need for technology).

Twenty-two technology immersion schools, selected through the competitive grant process, were matched by researchers with 22 control schools on key characteristics, including size, regional location, demographic characteristics, and student achievement. (See Appendix A for technical details on the research design and site selection.) The data in Table 2.1 compare the baseline characteristics of immersion and the control schools. Information for individual campuses is provided in Appendix B.

Table 2.1. Baseline Characteristics of Immersion and Matched Control Campuses

Indicator	Immersion N=22	Control N=22
Number of students	8,668	9,501
Number of sixth-grade students	2,930	3,265
Mean student enrollment	394	432
Number of teachers	596	669
Economically disadvantaged	71.3%	63.0%
Minority	69.1%	61.7%
Hispanic	60.2%	51.9%
African American	8.8%	9.8%
English as a Second Language (ESL)	12.9%	6.1%
Special Education	14.6%	15.3%
Student mobility	15.7%	16.7%
TAKS 2004, Passing All Tests	51.1%	53.1%
TAKS 2003, Passing All Tests	65.5%	67.0%

Source: Texas Education Agency; AEIS 2004
Note. TAKS (Texas Assessment of Academic Skills). Differences between groups are statistically insignificant.

The Texas middle schools participating in TIP employ about 1,300 teachers and enroll about 18,000 students in grades 6, 7, and 8. The TIP grants targeted high-need schools—thus more than 60 percent of students come from economically disadvantaged backgrounds, with many schools in rural or isolated locations. Students are ethnically diverse, roughly 56 percent Hispanic and 10 percent African American. Results for statistical analyses of differences between groups showed that the percentages of economically disadvantaged, minority, English as a second language (ESL), and special education students were statistically equivalent across the treatment and control schools. Likewise, results for student enrollment, mobility, and TAKS passing rates for all tests taken also showed no significant

differences. These analyses indicate that treatment and control schools are well matched in terms of their pre-TIP characteristics. Moreover, both treatment and control samples include a range of campus and district enrollments and schools from diverse regions of the state

Theoretical Framework

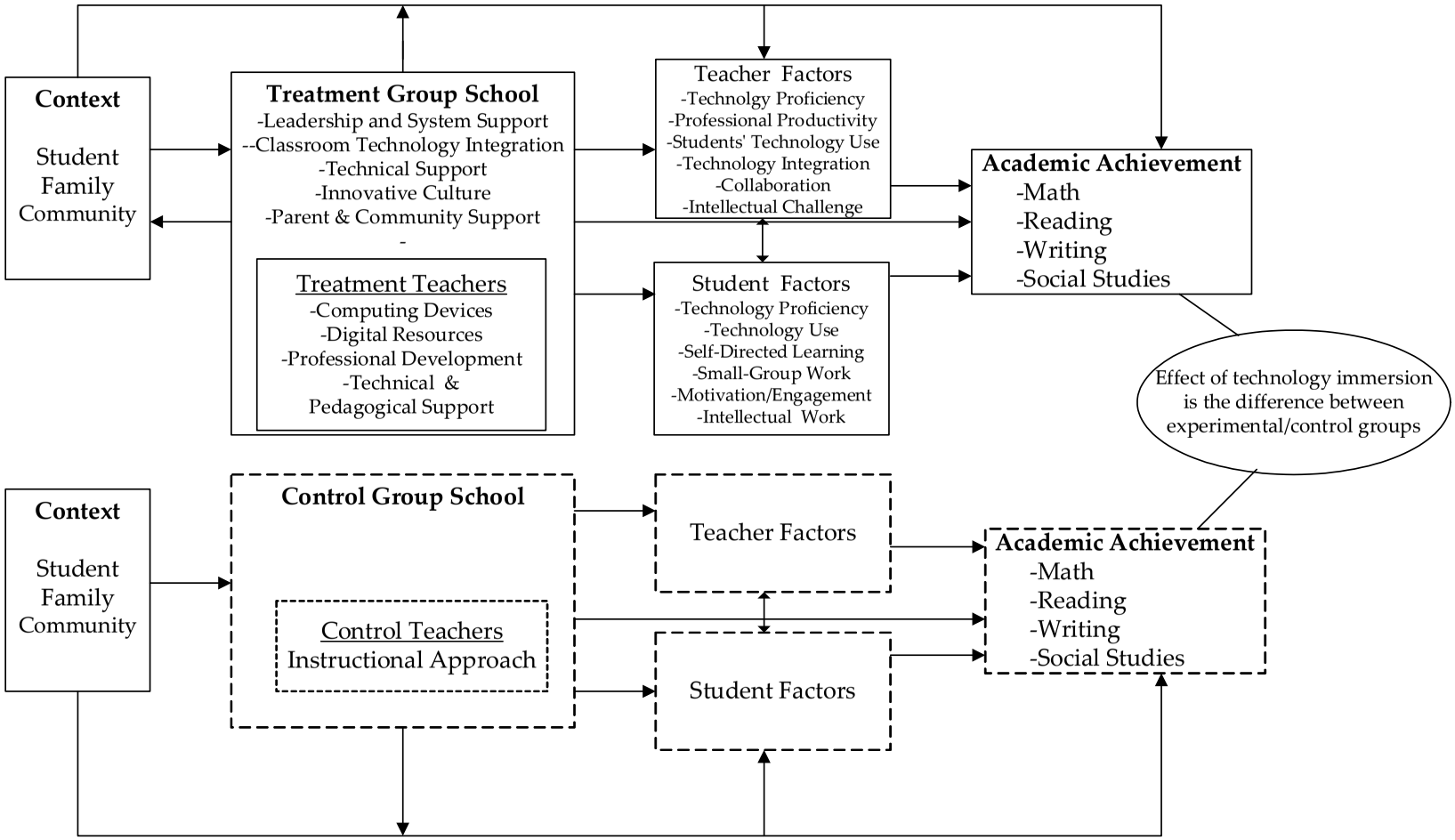
The evaluation is guided by the *Theoretical Framework for Technology Immersion* shown in Figure 2.1. As illustrated by the framework, the evaluation measures the effects of technology immersion by comparing student-, teacher-, and campus-level outcomes across experimental and control campuses. The framework assumes that immersion is a process that begins with implementation and is structured in terms of linear, causal relationships that move schools toward full immersion. Guided by strong leadership and effective system support, experimental, or treatment, schools begin the process of immersion through the introduction of broad-based technology resources. System support for immersion is provided through professional development designed to facilitate teachers' integrated use of technology resources in the classroom and through readily available technical and pedagogical support services. The framework expects that the effectiveness of leadership and system support for immersion will be evidenced in the teachers' and students' levels of access to wireless technology, teachers' effective classroom use of online curricular and assessment resources, as well as school-level improvements in measures of classroom technology integration, innovative culture, technical support, and parent and community support.

As schools progress towards full immersion, teachers are expected to demonstrate greater technology proficiency, use technology more for their own professional productivity, collaborate more with their peers, incorporate more student activities with technology in their classrooms, and use laptops as a tool to increase the intellectual challenge and relevance of their lessons. In turn, these shifts in teacher behavior are expected to improve students' technology proficiency, engagement in school and learning, and personal self-direction as well as to provide greater opportunities for student collaboration. And as students become more engaged and self-directed in their approach to learning, they are expected to improve their academic performance, as measured by standardized test scores and attendance, and their behavior. The framework also includes links between student achievement and student, family, and school characteristics that also may affect learning.

Data Collection Methods

From September to November 2004, researchers conducted site visits at each of the participating campuses (22 treatment and 22 control). Researchers returned to campuses between March and May 2005 for follow-up visits. Campus visits typically involved teams of two to three researchers who collected data for one to two days. Researchers were paired in a rotating sequence that ensured each researcher was paired at least once during site visits with each of the other researchers.

Figure 2.1. Theoretical Framework for Technology Immersion



During site visits, data collectors conducted audiotape-recorded interviews with principals, technology coordinators, and central administrators as well as focus groups with a sample of sixth-grade core content-area teachers and students. Additionally, researchers surveyed technology resources during building "walkthroughs." The table below summarizes the number of data collection events occurring during site visits in fall 2004 and spring 2005.

Table 2.3. Data Collection Summary for Site Visits

	Number in Fall 2004			Number in Spring 2005		
Data Source	Immersion	Control	Total	Immersion	Control	Total
Principal interviews	19	21	40	22	21	43
Tech coordinator interviews	20	20	40	22	21	43
Central admin. interviews	--	--	--	21	--	21
Focus groups (# of teachers)	23 (120)	26 (128)	49 (248)	24 (113)	26 (112)	50 (225)
Focus groups (# of students)	--	--	--	22 (143)	21 (140)	43 (283)
Building walkthroughs						
Classroom	130	121	251	135	141	276
Computer labs/classrooms	38	48	86	51	33	84
Library	20	15	35	20	20	40

Sources

Data collection sources for the study included building "walkthroughs," campus inventories, interviews, and focus groups.

Building Walkthrough. At each site, researchers conducted a building "walkthrough" that involved recording descriptive notes on the availability of resources in computer labs and technology applications classrooms, the library, and a sample of classrooms (about 25 percent of classrooms at each school). During the walkthrough, researchers observed each class for about five minutes and recorded information on the availability of technology resources (e.g., laptop and desktop computers, LCD projectors, printers, and televisions). Researchers also noted the use of technology by teachers and students and the types of technology used in the setting (e.g., word processing software, presentation software, Internet for research, online resources). Researchers conducted observations at times when students were in classes or other academic settings. In fall 2004, we recorded walkthrough information for a total of 251 classrooms (130 immersion and 121 control), 86 computer labs or technology applications classrooms (38 immersion and 48 control), and 35 libraries (20 immersion and 15 control). In spring 2005, we recorded information for a total of 276 classrooms (135 treatment and 141 control), 84 computer labs or technology applications classrooms (51 treatment and 33 control), and 40 libraries (20 immersion and 20 control).

Campus Technology Inventory. The instructional technology coordinator for each campus completed a Campus Technology Inventory in fall and spring to document the availability of technology. Survey items addressed technology access in the school and classrooms as well as technical and pedagogical support. In both fall and spring, coordinators for 22 immersion and 21 control schools completed inventories.

Interviews. Researchers conducted semi-structured interviews with campus principals and technology coordinators at all sites. Fall interviews centered on the pre-technology immersion conditions at each site. Interviews in spring 2005 varied by comparison group. Interviews at treatment campuses concentrated on the implementation of technology immersion and changes that occurred during the school year. Interviews at control sites explored changes in technology access and use and the implementation of other initiatives that might affect the study's outcomes. In the fall of 2004, we interviewed 21 principals at treatment sites; one principal was on personal leave and unavailable. We interviewed all of the 22 principals at control sites. Technical problems with audiotapes, however, reduced the number of usable

interviews to 40 (19 treatment, 21 control). In the spring of 2005, we interviewed 22 treatment and 22 control principals. However, technical problems with the audiotape of one control principal reduced the total number of interviews to 43 (22 treatment, 21 control).

Campus technology coordinators encompassed a wide range of positions (e.g., hardware technician, technology trainer, curriculum integration specialist). In fall, interview questions addressed project planning, teaching and learning with technology, professional development, and access to and use of technology. In spring 2005, interviews with technology coordinators on control campuses addressed the use of TIP funds, school or district initiatives that may have affected technology use, and changes in access to technology use over the course of the school year. For treatment campuses, interview questions addressed the implementation of technology immersion, the characteristics of technical and pedagogical support, the impact of immersion on coordinators, and changes in access to technology. In the fall of 2004, we interviewed 40 technology coordinators (20 treatment, 20 control), and in spring 2005, we interviewed 43 coordinators (22 treatment, 21 control).

In spring 2005, we also conducted interviews with district-level administrators directly involved with TIP implementation on immersion campuses. The district-level administrators interviewed included superintendents, assistant superintendents, district curriculum coordinators, and district technology coordinators. Interviews focused on administrators' roles in the TIP project, their views of the project's successes and challenges, and the issues involved in continuing the project in the coming 2005-06 school year. A total of 21 district-level administrators were interviewed in the spring of 2005.

Focus groups. In fall 2004, focused teacher discussions involved groups of six to eight sixth-grade teachers of core academic subjects (reading/English language arts, mathematics, science, and social studies). On each campus, we held either one or two teacher focus groups, depending on the number of teachers. The fall discussions on both treatment and control campuses explored teachers' access to and use of technology in the classroom, the training available for classroom technology use, and the level of collaboration and support for technology integration. In spring 2005, we again conducted focus groups with sixth-grade core-subject teachers (groups of about six to eight). For the most part, discussions involved the same teachers in fall and spring. The spring discussions with treatment teachers focused on the immersion project's effects on teachers' access to and use of technology, their assessment of TIP professional development and instructional resources, and their views of immersion's effects on students. On control campuses, focus group discussions explored teachers' ability to access and use technology resources as well as their assessment of TIP-funded professional development. A total of 248 teachers participated in 49 discussion groups in fall 2004 (230 treatment, 128 control teachers). In spring 2005, a total of 225 teachers participated in 50 focus group discussions (113 treatment, 112 control).

In the spring of 2005, we also held focused discussions with a randomly selected sample of sixth-grade students at each treatment and control campus (about six to eight students per group). On treatment campuses, focus group discussions probed students' perceptions of the immersion project, their access to and use of technology in and outside of school, the challenges involved with using laptops, their level of collaboration with other students, and the personal impact of using a laptop. On control campuses, student discussions explored students' understandings of technology use in school, their access to and use of technology in and outside of school, the challenges involved in using computers, and their level of collaboration with other students. A total of 283 students participated in a total of 43 focus groups discussions in the spring of 2005 (143 treatment, 140 control).

Training procedures. Prior to fall 2004 site visits, researchers participated in a two-day training event. Training activities informed data collectors about the research design, aspects of technology immersion, data collection protocols, and effective interview and focus group techniques.

Data Analysis

After data collection, audiotapes were transcribed verbatim. Data files were then imported into ATLAS.ti for category development and thematic analysis. The research team categorized a sample of interview data to develop the initial codes identifying the content of respondents' comments, and, once reliability was established, coded all interview and focus group responses. Coded output was then summarized through the use of tables organized by campus and content of response. This approach enabled researchers to examine data holistically for a single site as well as to examine trends across campuses. Across interviews and focus groups, codes focused on the role of technology in supporting student learning; the challenges of implementing a technology immersion project; the effects of the project on students, teachers, and classroom instruction; the level of support for the project from school administrators, teachers, parents, and community stakeholders; the effects of immersion on school policies; the characteristics and quality of teacher professional development; and student and teacher use of package resources.

Researchers analyzed baseline data for control campuses using procedures as described above. However, different procedures were used in spring. Following spring site visits to control campuses, researchers reviewed notes and audiotapes as a way to determine the extent to which technology conditions and practices had changed at each of the control campuses. Researchers wrote "reflections" on the school environment, administrative leadership, teachers and classrooms, students and learning, and changes in technology and other educational initiatives since fall visits. Analyses of reflections revealed that little had changed at control campuses since fall (teacher and student survey data also confirmed stable conditions at control campuses). Control campuses in spring had similar access to technology, continued to use technology in similar ways, and continued to pursue their educational missions as articulated during fall site visits.

3. Baseline Characteristics of Participating Schools

This section describes the patterns of technology access and use prior to the Technology Immersion Pilot (TIP). Baseline data collected during site visits in fall 2004 helped to establish the comparability of treatment and control schools, an essential part of quasi-experimental research. The section begins with a review of the existing technology resources and technical support issues. Next, researchers explain how districts and campuses offered technical and pedagogical support for technology, and describe teachers' opportunities for professional development. In light of existing conditions, we then describe how teachers and students used technology. Throughout the section, we highlight similarities and differences between treatment and control campuses. Data sources include building "walkthroughs," a Campus Technology Inventory, interviews with principals and technology coordinators, and focus-group discussions with teachers and students.

Existing Technology Conditions

Access to Technology

Favorable access to technology for teachers and students requires a strong technology infrastructure, including computers, peripherals (e.g., printers, scanners, projectors), and network and Internet connections as well as instructional and basic applications software. Technology access and use in classrooms and the school also requires adequate and ongoing support (e.g., Shapley et al., 2002; Becker, 1999). As a way to understand existing technology conditions at treatment and control schools, researchers conducted "walkthroughs" and recorded descriptive information for campus computer labs, technology applications classes, libraries, and a sample of core-subject classrooms. Additionally, campus technology coordinators, principals, teachers, and students offered their views on historical and current technology issues.

School and Classroom Access

Evidence revealed that school and classroom access to technology in fall 2004 was nearly identical at treatment and control campuses, and differences that emerged typically favored control campuses (Table 3.1).

Classroom computers. In the observed sample of classrooms (English language arts, mathematics, science, and social studies), technology was scarce. Teachers, on average, had fewer than three desktop computers per classroom (2.5 and 2.8 for treatment and control, respectively) and less than one printer per room (0.8 and 0.7). Moreover, observers rarely saw laptop computers in any classrooms (0.3 per room), and Liquid Crystal Display (LCD) projectors also were scarce (0.2 per room). Numerous teachers also mentioned in focus groups that computers in their classrooms were inoperable or outdated. Typically, there was at least one functional classroom computer, and this was used by the teacher primarily for administrative work. Teachers also commonly used their computers for preparing lesson plans and accessing the Internet. Even though many teachers had two or three computers in their classroom, none had enough to permit the entire class to work on projects simultaneously. Several principals also noted that trying to cycle many students through a limited number of computer workstations made student technology use difficult.

Table 3.1. Access to Technology Resources in Middle Schools, Fall 2004

Location/availability	Immersion N=22	Control N=22
Core-subject classrooms[a]		
Mean number of desktops per class	2.5	2.8
Mean number of laptops per class	0.3	0.3
Mean number of printers per class	0.8	0.7
Mean number of LCD projectors per class	0.2	0.2
Computers labs[a]		
Mean number of labs	1.9	2.3
Mean number of computers per lab	22.5	21.5
Library[a]		
Mean number of computers	13.0	12.7
Mobile laptop carts[b]		
Mean number of carts per campus	0.9	1.1
Mean number of computers per cart	18.1	16.1

[a] Statistics from building walkthroughs. Computer lab refers to a lab or technology applications classroom.

[b] Statistics from Campus Technology Inventories completed by technology coordinators in fall 2004.

Computer labs. Across all middle schools, computers were generally concentrated in computer labs (or technology applications classrooms) and libraries. Control campuses had slightly more computer labs (2.3, on average) than did treatment schools (1.9). The average number of computers per lab, however, was nearly equal (22.5 for treatment versus 21.5 for control). Libraries had about 13 computers, on average, at all campuses. At about one-fourth of campuses, teachers said that access to computer labs was limited. Teachers competed for available time in the computer labs and described difficulties scheduling lab time for their classes. One teacher commented, "I've been trying to get into the computer lab for the last two weeks and I haven't been able to." Another said, "We're limited as far as we have to coordinate to share the resources…and so it makes it difficult."

Despite limitations, most student computer use took place in labs. According to teachers, almost all of the campuses had computer labs for students, and about two-thirds of campuses also had computers in the library that were available for student use. Faculty at some campuses mentioned having multiple computer labs for students. No matter the access patterns, teachers from both treatment and control campuses said there were too few computer resources in classrooms and labs for their students.

Mobile laptop carts. Although teachers seldom had laptops in their classrooms, about half of the middle schools had mobile laptop carts with sets of laptop computers available in a central location for checkout. Overall, availability of laptop carts varied little by treatment and control campuses, with about one cart per campus outfitted with 16 to 18 laptop computers. Campus-to-campus differences, however, existed within comparison groups. Moreover, teachers at all campuses frequently mentioned problems with mobile computer labs. They described problems with both the mobile computers themselves and the Internet access. For instance, one teacher said:

> We do have access to the Computers on Wheels … But my experience with them is that every time I've tried to use them, they didn't work. So there are always major, major problems, like, with the wireless connections, or the batteries didn't last long enough. They've been more of a headache than a help.

Overall, teachers reported significant hardware-related problems with computers on their campuses and this discouraged many from using technology in their lessons.

Problems Affecting Technology Access

Technology coordinators at all campuses described the technology-related problems their campuses encountered most often, including issues with hardware, software, and the Internet, and a lack of personnel expertise, which hindered their attempts to advance instructional technology. Roughly equal numbers of treatment and control campuses encountered the same technical problems, although a shortage of technical staff and software issues were more prevalent at treatment schools.

Hardware. Nearly half of technology coordinators at both treatment and control campuses described persistent hardware problems. At most campuses, insufficient funding contributed to hardware that was either obsolete or non-functioning. Outdated equipment required frequent repairs, ran slowly, and did not support current software applications. One technology coordinator said, "When we were putting on the *Reading Coach* for summer school here, we were hard pressed to find 10 computers that had the memory to hold the programs in one of the labs." Another coordinator described how the funding cycle contributed to perpetual obsolescence:

> Our budgets are so limited and you get the equipment, but then you don't have enough software. You get the software, but then you don't have training to really know how to use it. You don't have the evaluation piece in place like it needs to be so that you can really evaluate the effectiveness. By the time we get the pieces in place in a small district like this, then you turn around and it's obsolete.

Teachers also reported problems with technology that was outdated or inoperable. At half of treatment campuses and one-third of the control campuses, teachers said that hardware problems discouraged them from using technology in their lessons.

Software problems. A few technology coordinators described software problems such as incompatibility between platforms, incompatibility between software and the operating system, and unidentified software problems. Coordinators also described problems with gradebook software. At one-fourth of campuses (representing roughly equal numbers of treatment and control campuses) problems with gradebook software (e.g., WinSchool, eClass) caused frustration for teachers and absorbed technicians' time for repairs.

Network and Internet. According to technology coordinators, the most prevalent technical problems involved the campus network. Nearly half of technology coordinators reported problems with network failure. They said campuses endured frequent and sometimes extended service interruptions and slow Internet connection speeds. Network problems prevented teachers and students from accessing email and gradebook software and discouraged teachers from using the Internet. Nearly one-third of the coordinators said that computer viruses, pop-ups, worms, and spyware also caused problems. While for some campuses these problems were merely an inconvenience, others lost considerable amounts of stored information and software.

As a whole, technology access was meager at both treatment and control campuses in fall 2004. Teachers had few classroom computers and limited equipment, and although all schools had computer labs, scheduling difficulties restricted regular access. Technical problems caused by outdated and inoperable equipment, software issues, and campus network and Internet problems also limited access to technology.

Technical and Pedagogical Support

Research underscores the importance of on-site technical and pedagogical support personnel in supporting technology immersion (e.g., CEO Forum, 2001; Ringstaff & Kelley, 2002; Texas Education Agency, 2002). Consequently, during site visits, researchers asked teachers and technology coordinators about the

mechanisms of technical and pedagogical support available at their campuses. This information contributed to composite descriptions of the existing methods and levels of support at treatment and control campuses, and provided a general description of the availability of technology support personnel, work assignments, the locus of support, and technology help-seeking behavior among teachers. While the descriptions revealed a broad range in the levels and configurations of support, most campuses had technical support for hardware and software and at least some pedagogical support for integrating technology into the curriculum.

Models of Support

Analyses of campus support mechanisms revealed no clear differences between treatment and control campuses. Both seemed to have similar configurations for handling technology and integration issues, and campuses appeared to have one of a few models of support. As Table 3.2 illustrates, models of technical and pedagogical support included assistance either from (a) multiple levels at the campus and district, (b) a single person in charge of all support operations, (c) part-time or off-site support mechanisms, or (d) no formal support mechanism at all.

Table 3.2. Models of Technical and Pedagogical Support

Model	Description
Multilevel team	Various people on campus share responsibilities and assume different but over-lapping functions; district is directly involved and provides oversight.
Coordinator with various roles	One person on campus provides dedicated technical and/or pedagogical support. (This person may also support grant activities.). In some cases, roles may be shared between two people on same campus, who serve various other assignments (teacher, administrator, grant specialist).
Part-time support	Campus relies on part-time or off-site technical support providers (private companies or district personnel housed off campus).
No direct support	There is no clear mechanism for technical or pedagogical support.

Multilevel team. In one prevalent model, various people on the campus shared responsibilities and assumed different, but overlapping, functions. In most cases, the district was also involved directly and provided oversight. Take, for instance, the following exemplar description:

> The campus technology coordinator is the primary contact for technology-related issues at the school. The coordinator works with the district to fix complex technical problems and network issues, maintains the grading software, schedules labs, troubleshoots software, and plans technology purchases. An Intel-certified master teacher on campus trains other teachers on issues related to integrating technology into instruction and a few teachers maintain the campus website. The district's instructional technology division provides professional development and technical support for the district. The district also provides a "help desk" for networking problems [large campus and district].

In a number of cases, especially those without careful orchestration, the multilevel team approach left teachers confused about training opportunities and avenues for support.

Coordinator with various roles. Many campuses had one person in charge of all technology-related needs. Oftentimes, this person handled hardware, software, purchases, training, and network issues. Some also supported grant activities. While their job included working with curricular integration, few coordinators were able to provide comprehensive assistance:

> The campus technical support staffer repairs hardware, installs and troubleshoots software, and helps teachers integrate technology into lessons through one-on-one assistance and modeling. For smaller technology questions and problems, teachers rely on the secretary and the art teacher. The

> librarian helps with various software applications. Complex hardware issues are handled by a local computer business [small campus and district].

Part-time support. A number of campuses, especially smaller ones, relied on part-time or off-site technical support providers. Off-site technical support providers visited campuses infrequently, which burdened some technology-savvy teachers with time-consuming repairs, as one technology coordinator explained:

> The campus does not have an on-site technology specialist. The technology coordinator for the district repairs hardware, installs software, maintains the network support, and provides pedagogical support. Teachers call the help desk with questions/problems and rely on teachers with technology expertise. The eighth-grade keyboarding teacher keeps the campus software up to date [small campus and district].

No direct support. Several campuses had no clear mechanism for providing technical support for technology. These campuses relied on teachers and administrators to address technology needs:

> Teachers help each other with technology integration by sending each other web sites and showing each other how to use the sites for lessons. For technical support, teachers rely on the librarian, a secretary, the technology teacher, and their students [large campus and district].

Findings also indicated that direct support for and control over infrastructure and hardware was typically concentrated at the district level or with other off-campus entities, whereas campus personnel provided more direct support for troubleshooting, classroom technology integration, and software.

Personnel and Proficiency Problems

Shortage of well trained and capable staff. Technology coordinators described two personnel issues affecting technology access and use on their campuses. First, several coordinators at small campuses described a shortage of well-trained technical staff capable of handling all the campuses hardware and software needs. As noted above, a few campuses did not have any technology personnel on staff, while others had a technology staff with limited training and experience, or who divided their time among other duties, including that of teacher, federal programs administrator, or librarian. A few technology coordinators also said their campuses had no formal process for dealing with technical issues. Instead, teachers used the means with which they felt most comfortable for meeting their technology needs, including going to other teachers, calling vendors, informally asking technology coordinators, or discontinuing use.

Teachers' limited technology proficiency. Several technology coordinators believed their ability to address technical support and integration issues was hampered by a lack of teacher technology proficiency. Because teachers lacked technical skills, some technology coordinators felt overwhelmed by training demands. Other coordinators said that teachers were unable to troubleshoot small problems such as forgetting to turn on the monitor, not checking to ensure a device was plugged into an outlet, or forgetting passwords. One technology coordinator said, "If the teachers will just learn how to do just basic troubleshooting, to look to see if the network cable is unplugged, simple things like that." Teachers echoed coordinators' views, saying they wanted training on troubleshooting.

Teacher Help-Seeking Behavior

Teachers were consistent in their help-seeking behavior and sought input and assistance from one another before contacting technical support personnel. Although teachers helped one another with technology needs, they tended to have limited technical proficiency in software applications and even less ability in terms of technology integration.

All in all, teachers' access to capable technical and pedagogical support for technology varied widely across both treatment and control campuses in fall 2004. The level of support ranged from a comprehensive campus and district team to no formal support mechanism. Campuses' limited ability to provide technical support resulted from shortages of personnel, technical staff with limited training and experience, or support staff with multiple duties. Teachers' limited technical proficiency increased technology coordinators' work loads. Despite teachers' apparently limited proficiency, they consistently looked to one another for help with technology.

Professional Development

Texas has long recognized that teachers must continually improve their personal technology proficiencies and effectively integrate instructional technology if students are to acquire the skills needed to be successful in the 21st Century (TEA, 2000; 2002). Currently, the state requires all teachers to demonstrate "technology literacy" by mastering Technology Applications Standards. The No Child Left Behind (NCLB) Act of 2001 also advances the effective use of technology by teachers. Enhancing Education Through Technology grants (NCLB Title II, Part B) require recipients to direct 25 percent of grant funds toward educator development. Thus, TIP grantees were required to invest a quarter of their funds in professional development (both treatment and control schools).

Fall site visits allowed researchers to gather information from educators on the kinds of technology-related professional development available to teachers, what they had participated in during the last year or so, and their existing needs. Taken together, this information helped researchers to understand teachers' background of experience with technology, and for treatment campuses, how prepared teachers were for immersion. In general, treatment and control campuses appeared to be similar in terms of the provision of technology-related professional development for teachers, and campuses faced similar barriers to teacher participation.

Training Providers

Teachers and technology coordinators at treatment and control campuses cited various professional development sources including the school district, the regional education service center (ESC), university courses, librarian conferences, summer teacher institutes and academies, Texas Computer Education Association (TCEA) conferences, and previous technology grant programs (e.g., TARGET). Professional development was provided less often by a campus specialist or a teacher.

Technology coordinators indicated that technology-related professional development was widely available to all teachers, and at about half of campuses, district staff led technology training. Several districts provided access to online courses or computer-based tutorials. On the other hand, at many campuses, especially in small districts, staff development was available at regional ESCs. A few campuses contracted for professional development or paid for off-site training. About a quarter of campuses provided on-campus training facilitated by the campus' technology coordinator, staff trainer, technology teacher, or librarian.

Content Focus

Professional development content was similar across treatment and control campuses and tended to focus on technology operations and productivity rather than integrated lessons.

Understanding basic computer literacy and the Internet. Teachers at nearly all campuses reported access to training covering basic computer literacy skills, and at about half of campuses, teachers reported that training was available in accessing the Internet and using online educational resources. Teachers and technology coordinators mentioned productivity applications such as PowerPoint, Word, Excel, and

PhotoShop as well as educational resources such as AIMS (Activities Integrating Math and Science). Respondents also mentioned training on resources such as SchoolNet (an instructional management system) and WebCCAT (a web-accessible bank of assessment items).

Using technology hardware and equipment. At about one-third of campuses, teachers participated in training on the use of laptops, graphing calculators and temperature probes, LCD projectors, digital cameras, and Palm Pilots. Some teachers also said they were trained in troubleshooting technology problems.

Integrating technology into lessons. At about one-fourth of campuses, teachers and technology coordinators reported that training was available on integrating technology into lessons. Some respondents noted that they or their colleagues had participated in the Intel Teach to the Future program, which includes a series of classes for teachers who then return to their campuses and train others. At one campus, teachers had integrated technology components into a lesson plan, while at two other campuses, informal professional development included sharing information among teachers through a campus website devoted to lesson plans and electronic resources.

Meeting technology proficiency requirements. About a quarter of campuses had specific procedures to ensure that teachers mastered technology proficiency requirements. At some campuses, teachers had to pass proficiency tests, and at other campuses, teachers completed a determined number of technology training classes or hours during the year.

Training Design

Technology coordinators at all campuses reported that teachers received "one-on-one" assistance, which was provided by master teachers, campus technology coordinators, computer lab teachers, technology-savvy teachers, and sometimes even students. For example, one coordinator said:

> Most of the training that I've done with them has been one-on-one because the reality of the situation was I was teaching class, they were teaching class, and it was hard. Whenever they could get together with me and had a need, we would fill that need after school or during conference periods or whatever.

Two large districts, with both treatment and control campuses, provided programs to familiarize new teachers with available technology. New teachers in one district participated in a technology-orientation academy, whereas another district provided a mentoring program for new teachers.
Teachers believed that technology-related professional development should be designed for different skill levels, provided at an appropriate pace, supported with clear instructions, conducted in small groups, and involve hands-on activities. In addition, several teachers said they needed follow-up training and retraining opportunities. Teachers also wanted trainers to model lessons using technology, be available for one-on-one assistance, and serve as an on-campus resource for technology questions. One teacher commented:

> I think we need people who have used technology a lot in their classroom, actually in their classroom, not just people who have heard about people who have used it in their classrooms, to come in and tell us and show us. Like, I need a reading teacher to come in and say, 'This is what you can do. And these are some of the lessons that I've used'.

Barriers to Participation

Insufficient time. Teachers at all campuses described similar deterrents to participating in technology-related professional development, including insufficient time to attend trainings and practice skills. One teacher explained, "I would sign myself up to these workshops one day and when I'd come back I'd

forget what's going on there because I couldn't apply it because I was busy trying to teach what I needed to cover in my classroom.

Insufficient classroom technology. Another key deterrent to participation in technology professional development was the lack of technology available in the classrooms. Teachers saw little value in attending training when they had few technology resources with which to practice new skills and to apply them in the classroom. One teacher commented, "All the after-school professional development in the world is great, but if we can't implement it and we don't have the resources to implement it, it's useless." Other teachers reported that they did not engage in more training, or use technology more often, because they lacked software applications and tools relevant to their academic area.

Fear of technology. Teachers at a few campuses described a fear of technology as a deterrent. They were afraid of crashing or breaking the computers, or not knowing how to direct the students in using computers in the classroom. At one campus, however, teachers said their fear of technology motivated them to take a computer class.

Current Technology Needs

Teachers specified several priorities for technology-related professional development, including training on productivity software, equipment and troubleshooting, Internet resources, and technology integration.

Using productivity software, equipment, and troubleshooting. At several campuses, teachers said they needed professional development on basic productivity software, including Microsoft Office and related software applications. Teachers at other campuses wanted advanced training on applications. Some teachers also needed more training on using technology equipment. Teachers at several campuses needed training in troubleshooting hardware-related problems. One commented, "If it freezes, you know, do you know how to get out of what you were doing to get it going again? If your mouse isn't working, do you know what to do before you call the tech?

Accessing resources and integrating technology. Teachers at a few campuses wanted more training in accessing the Internet and using online educational resources. More commonly, however, teachers indicated they needed more professional development in integrating technology into the curriculum. For instance, one teacher said, "I would want somebody to come show me how to be most effective with that technology in my classroom and get the most out of it where I can replace something yet not overlook anything." Teachers from treatment campuses, recognizing their coming challenges, placed a high priority on training focused on introducing laptops and appropriate use policies to students and monitoring students' classroom use of technology.

Overall, technology-related professional development was widely available and tended to focus on computer literacy skills, accessing the Internet, and using online educational resources rather than on integrating technology into lessons. Insufficient time for learning and practice and insufficient classroom technology were key deterrents to teacher participation in technology-based professional development. Although teachers had numerous training needs, many requested more help in integrating technology into the curriculum, and they wanted technology-savvy trainers to model lessons and serve as on-campus resources.

Teachers and Teaching

In fall, teachers at both treatment and control campuses believed technology had limited instructional value because they had few reliable computers in their classrooms. Other teachers did not incorporate existing technology into their lessons because they were inadequately trained. Consequently, teachers

were not integrating technology into the curriculum to a great extent on any campuses. When used, computers were primarily a tool for completing administrative tasks or accessing instructional resources and the Internet.

Complete Administrative Tasks

Teachers at half of treatment campuses and about a third of control campuses routinely used electronic gradebooks, attendance reporting software, and email. Some teachers mentioned Microsoft Office products such as Word and Excel and a few teachers used PowerPoint. Consistent with this, about half of the principals said their teachers used computers for administrative tasks such as reporting grades and attendance. Many principals said that teachers used technology for communication with other teachers, parents, and students through email. Principals at two schools characterized teachers' typical technology use: "Prior to the grant, the main purpose of their computer in their classroom was for grades. Another principal said, "All of our grades and attendance are done on GradeSpeed, and of course we have got email and IM that teachers use to communicate.

Some principals and teachers also said teachers have started to write lesson plans and share them online. The principal at one campus stated, "We started doing our lesson plans electronically two years ago, and they emailed them to me. We used a template, and they just used a Microsoft Word document and they emailed it to me every week."

Access the Internet and Educational Resources

Numerous teachers said they occasionally used the Internet. Although classroom computers were limited, teachers said their students sometimes accessed the Internet either in the classroom, computer labs, or library. Teachers at about a quarter of campuses also had their students use educational software and/or interactive educational websites. Applications mentioned by teachers included BrainChild, CoolMath, AlphaSmart, NewCentury, ReadingCounts, Plato, and Inspiration. Many teachers also had students use classroom computers for the Accelerated Reader program. In addition, principals at more than a quarter of campuses had observed teachers using technology for research or to find instructional resources on the Internet. One principal explained, "Our history teachers go online, and there are a lot of websites with history web-based information that they can download, and they can also download maps and charts and stuff like that."

Create Technology-Integrated Lessons

Although most teachers' said technical problems and limited computer resources deterred their use of technology for instruction, several teachers said they were using educational technology in their lessons. Teachers' responses reflected the great range in teacher proficiency and use of technology across campuses. One principal described the pattern: "We have teachers that are very technologically literate and they do extremely well at integrating technology in instruction. And we have some teachers that are at the other level—they're afraid to try it." One technology-savvy teacher described a typical lesson using technology:

> We've done online interactive lessons, but it's whole group. I flash it on the TV and the kids work at their desks with me. The one particular one that I'm thinking of, we worked with manipulatives and they got feedback from the online program.

Several principals observed some teachers using technology in the classroom. Typical lessons included using the Internet for research and using Microsoft Office products, such as word processing and spreadsheet software. One principal described a teacher's lesson:

> She does projects also in her classroom. Like right now that we have Halloween right around the corner, they're writing stories, and she expects them to have pictures, and they pull up from the computer pictures that go with the story.

Principals also observed teachers using PowerPoint and LCD projectors to deliver lessons. One principal gave an example:

> The [LCD] projectors are very popular… the overhead projectors are going out. These projectors are much easier to work with. The quality of the projector really makes a difference because the kids can really see the problems on the white board.

Taken as a whole, few teachers in fall were integrating technology into their lessons to a great extent. Rather, teachers used computers for administrative tasks such as reporting grades and attendance, or used the Internet as an educational resource. Although technology access was limited, a few teachers who had greater expertise in using and integrating technology had developed strategies for using technology in an environment with limited computer resources. Commonly cited strategies included rotating student use of classroom computers as well as the use of library computers and computer labs

Students and Learning

As a way to understand the typical patterns of student technology use at both treatment and control campuses prior to technology immersion, researchers asked principals and teachers about their students technology use. In fall, students most frequently used various technology applications and educational programs, researched topics on the Internet, made presentations, or used word processing programs to type essays or reports.

Use Technology Applications and Educational Programs

Principals and teachers described students' use of a variety of software applications. Common applications included video-creating software, Word, Excel, PowerPoint, Photoshop, Perfect Copy, instant messenger, and iMovie. Educational programs typically targeted core academic subjects: A+ Math online, Accelerated Reader, STAR testing, Plato Learning, Study Island, Grammar Coach, and Compass Learning. Other programs allowed students to have "virtual" experiences such as visiting museums or dissecting animals. Some students also had opportunities for semantic mapping with Inspiration software. In addition, teachers and principals commonly reported student use of graphing calculators. Accelerated Reader (AR) was mentioned frequently. Half of the treatment and control principals said AR was an essential component of their reading programs.

Research Topics on the Internet

Most teachers and principals said students' assignments incorporated Internet-based research, including Internet-based Webquests. Nearly all teachers used the Internet for research. One teacher explained, "I have four computers. We use them for Accelerated Reading. I also use them for my children to do research. They do their research for book reports."

Make Presentations and Write Compositions

Principals and teachers also indicated that their students were using technology to make presentations, especially with PowerPoint software. At both treatment and control campuses, about half of teachers assigned technology-based presentation assignments. One teacher reported:

> They do a PowerPoint presentation. Like our eighth-grade research project is on "Decades in the 20th Century," and they have to research like three different things out of that decade, and then their PowerPoint presentation shows what they have learned in their research from that book.

Principals and teachers also reported that students used computer word processors to type essays and write reports.

In general, students at some campuses used technology much more frequently than did students at other campuses; however, the range of student technology use was similar across treatment and control campuses.

4. Technology Immersion Pilot—Initiation Phase

Research shows that educational change occurs gradually, and when undertaking reform initiatives, schools move through phases from project initiation to early and more advanced stages of implementation (Fullan, 1999). This section explains how middle schools began to implement technology immersion. Analyses explore Technology Immersion Pilot (TIP) activities undertaken by districts and their immersion campuses early in the grant. The section begins with a description of the technology immersion packages provided by the three vendor leaders (Apple, Dell, and Region 1 ESC). Next, we provide an historical analysis of grant development and then describe planning and other activities that followed grant-award notification. Subsequently, we draw from respondents' comments to portray schools' level of readiness for immersion, and finally, we report principals' anticipated outcomes. Information on the initiation phase of immersion comes from interviews with principals and technology coordinators and focus groups with teachers at the immersion campuses.[1]

Technology Immersion Components

As a way to ensure consistent interpretation of technology immersion and comparability across immersion sites, the TEA issued a Request for Qualifications (RFQ)[2] that allowed the vendor community to apply to become providers of *Technology Immersion Packages*. Although state statute provided a general description of technology immersion, the concept had to be defined operationally to ensure consistent implementation. To that end, successful applicants to the RFQ had to have the following six components in their plan:

- A wireless mobile computing device for each educator and student on an immersed campus to ensure on-demand access to technology;
- Productivity, communication, and presentation software for use as learning tools;
- Online instructional resources that support the state curriculum in English language arts, mathematics, science, and social studies;
- Online assessment tools to diagnose students' strengths and weaknesses or to assess their progress in mastery of the core curriculum;
- Professional development for teachers to help them integrate technology into teaching, learning, and the curriculum; and
- Initial and ongoing technical support for all parts of the package.

Because the RFQ included a variety of technology components, vendors had to create partnerships, with one vendor assuming primary leadership for each package. Through a competitive process, the TEA selected three lead vendors as providers of technology immersion packages (Apple Inc., Dell Inc., and Region 1 ESC). Table 4.1 provides an overview of the basic components within each package and the individual vendors that provide various components. Prices for immersion packages varied according to the numbers of students and teachers, the type of laptop computer, and the vendor package. Package costs ranged from about $1,100 to $1,600 per student. Of the 22 immersion sites, 6 middle schools selected the Apple package, 15 selected the Dell package, and 1 school selected the Region 1 ESC package.

[1] Of the 22 immersion principals in fall 2004, one was on personal leave, 2 interview transcripts were lost through technical problems, and 19 transcripts were analyzed.

[2] RFQ No. 701-04-020; *Technology Immersion Hardware, Software, Content and Professional Development Packages.* Responses due to the Texas Education Agency by March 22, 2004.

Table 4.1. Technology Immersion Components

Component	Apple *N*=6 Schools	Dell *N*=15 Schools	Region 1 ESC *N*=1 School
Wireless laptop computer	Apple iBook G4	Dell Inspiron or Latitute	Dell Inspiron
Productivity software	Apple-Works	MS Office eChalk	MS Office eChalk
Online resources	Various	Various	Various
Online assessment	*Standards Master*	*i-know*	*i-know*
Professional development	Apple model	Co-nect	Classroom Connect
Technical support	Apple	Dell	Region 1 ESC

Wireless Laptops and Productivity Software

All vendors offered a wireless laptop as the mobile computing device. Campuses could select either Apple laptops (iBook and MAC OSX) or Dell laptops (Inspiron or Latitude with Windows OS). For Apple laptops, *AppleWorks* provided a comprehensive suite of productivity tools, including Keynote presentation software, Internet Explorer, Apple Mail, iCal calendars, iChat instant messaging, and iLife Digital Media Suite (iMovie, iPhoto, iTunes, GarageBand, and iDVD). For Dell laptops, *Microsoft Office* included Word, Excel, Outlook, PowerPoint, and Access. In addition, *eChalk* served as a "portal" to other web-based resources included in the immersion package and provided student-safe email. Region 1 ESC offered both Dell and Microsoft Office products.

Online Instructional and Assessment Resources

Immersion packages also included a variety of online resources. Apple included the following online resources: *netTrekker* (an academic Internet search engine), *Beyond Books* from Apex Learning (reading, science, and social studies online), *ClassTools Math* from Apex Learning (complete math instruction), *ExploreLearning Math and Science* (supplemental math/science curriculum), *KidBiz3000* from Achieve 3000 (differentiated reading instruction), and *My Access Writing* from Vantage Learning (support for writing proficiency). Dell selected *netTrekker* (an academic Internet search engine) and *Connected Tech* from Classroom Connect (technology-based lessons and projects). Region 1 ESC selected *Connected Tech* but also added a variety of teaching and learning resources including *Unitedstreaming* (digital videos), *Encyclopedia Britannica*, *EBSCO* (databases), *NewsBank*, and *K12 Teaching and Learning Center*.

For the Apple package, *AssessmentMaster* (Renaissance Learning) provided a formative assessment in all four core subject areas. Both the Dell and Region 1 ESC packages included *i-Know* (CTB McGraw Hill) for core-subject area assessment. In addition, all campuses had access to the online Texas Mathematics Diagnostic System (TMDS) that was provided free of charge by the state.

Professional Development

Each immersion package included a different professional development provider. Apple used its own professional development model, whereas the Dell package relied on *Co-nect* (a commercial provider) to support professional development. Region 1 ESC used a combination of service center support plus others services offered through *Connected Coaching and Connected University.* Although the professional development models and providers differed, they all include some common required elements, such as the design of technology-enhanced learning environments and experiences, lesson development in the core

subject areas, sustained learning opportunities, and ongoing coaching and support. Individual districts and campuses must collaborate with vendors to develop their own professional development plans for teachers and other staff.

Technical Support

Each technology immersion package provider also was required to provide campus-based technical support to advance the effective use of technology for teaching and learning. Apple designed a Master Service and Support Program that leveraged its broad-based experience in one-to-one projects. Dell established a Call Center dedicated to technical support for TIP grantees as well as an 800 telephone number for hardware and software support. Region 1 ESC has an online and telephone HelpDesk to answer questions and provide assistance.

In sum, the TIP project is unique in its use of competitive grant funds to test the effectiveness of a specifically defined educational intervention. The RFQ process allowed the creation of technology immersion packages with common elements. Although the "treatment" is not identical across sites, the specification of a comprehensive technology intervention with specific components represents a major paradigm shift in Texas. Still, the complex nature of the treatment makes it even more important for researchers to be able to gauge how and how well the immersion packages are implemented in order to explain any differences in outcomes that may emerge.

Initial Steps toward Immersion

Developing the Grant Application

As noted previously, interested districts and associated middle schools responded to a Request for Application (RFA) offered by the TEA to become technology immersion schools. However, principals' descriptions of their campuses' approaches to the development of the TIP grant application revealed that leadership and staff involvement in the process varied widely across participating sites.

Involvement in Planning and Writing the Grant

The timing of the competitive grants affected the application process and staff participation. In January 2004, the TEA released the first RFA. During this first round, only 6 middle school campuses (2 Apple and 4 Dell) were selected in May as TIP sites. To increase the pool of middle schools, a second RFA was released in late May after most school personnel had left for the summer break. In the second round, an additional 16 middle schools were selected as TIP sites and notified in July. Consequently, second-round schools had little opportunity for broad-based participation in grant development and little time for planning before the school year started.

District and principal roles. Because districts responded to the RFA on behalf of eligible middle schools, most districts played an active role in the grant planning and application process. In about half of the immersion sites, the central office identified the RFA and brought it to the attention of the superintendent, the school board, and/or campus leadership. Central office staff in some districts wrote the entire application or hired grant writers to do the job. At the other end of the continuum, districts for two campuses simply gave their approval for campus leaders to pursue the grant and provided data for the application.

For the most part, principals provided oversight, orchestrated the writing process, and supplied data to grant writers. Some principals also wrote substantive pieces of the applications. For instance, at one middle school, the principal led a revision of the campus' long-range technology plan as part of grant

development. A third of principals, however, were either not involved in the RFA writing process at all, or were only minimally involved in the process by either providing data or hosting a planning meeting.

Teacher role. At more than a third of campuses (8), teachers were not involved in the grant planning or writing process at all, and in most cases, these teachers were unaware of the grant until they returned from summer vacation. On other campuses (6), a small number of teachers (one to three) served as writers or on planning committees, while the rest of the teaching faculty was not involved. Only three campuses apprised teachers before writing the grant application. In one instance, the campus solicited faculty input on the selection of their immersion package.

Other participants. A range of other people from within and outside the districts participated in the grant planning and application processes. In some cases, local universities were involved in planning and writing and were written into the grant as key partners. Meanwhile, one campus received assistance from its regional service center, and another school received help from Apple, Inc. In addition, several campuses turned to professional grant writers.

Research-Based Decision Making

Only one school used various research sources about one-to-one laptop projects (e.g., Rockman study) to better understand technology immersion, identify some of the challenges, and provide a basis for weighing the pros and cons before applying for the grant. The principal and district team used Apple's discovery tool as well as its own process for identifying curricular needs. The principal and campus technology coordinator shared these findings, as well as the body of research, with the district, the school board, and teachers before they completed the RFA. In addition, members of the school board, district, and school visited Henrico County and consulted with Apple on the project. The limited amount of time available for responding to the RFA, especially the second round, may have prevented other districts from taking a more research-based approach.

Most middle schools received notification about their TIP grant award just before researchers' conducted site visits in fall 2004, while for six campuses, several months had passed. Despite the divergent time frames, principals' and technology coordinators' comments provided insight into preparatory activities after grant awards were made.

Defining Project Roles and Raising Awareness

Since districts received awards rather than campuses, district personnel assumed primary responsibility for the grant, including handling the Notice of Grant Award (NOGA) and providing reports to the TEA.[3] While many principals said their districts were becoming facilitators by providing financial oversight, technical support, and staff development, and coordinating with campus technology staff, other principals seemed at odds with their districts. For instance, in one district that assumed responsibility for *all* initiation planning, a campus spokesperson said, "That was taken out of our hands."

Principals are expected to be leaders of technology immersion at their campus, and many campus and district leaders attended the TIP Leadership Institute sponsored by the TEA in July 2004 to learn more about the grant and evaluation guidelines. Even so, principals' comments revealed varied understanding of technology immersion. Some thought about it strategically, in terms of the various immersion components and how they might interact with one another. Others thought about technology immersion in

[3] The Texas Education Agency assigns a Notice of Grant Award identification number (NOGA ID) for each grant awarded. This project identification number is used on all amended applications and financial and programmatic reports required by the grant. Thus, the NOGA is the "official" conduit through which districts receive funds.

terms of what it should look like in the classroom. In some cases, principals who had not been a part of the grant writing or planning process had just learned about the grant. For instance, at one campus the principal said, “My first role is to find out what the grant entails.” Principals familiarity with and conceptualization of immersion seemed to influence how they presented the project to their staff.

At the start of the new school year, several districts and campuses held staff meetings to apprise teachers returning from summer breaks of grant requirements. Thus, at many campuses, teachers’ first role was becoming acquainted with the grant itself. One principal believed that teachers’ exposure to laptop computers would help them to see the “potential.” Other campuses, however, created steering committees and otherwise sought input from teachers. While principals at many immersion campuses had done little planning overall for TIP professional development in fall, they had identified the core training needs of teachers, and had an awareness of the critical role of technology-savvy teachers in coaching other teachers.

Addressing Policy and Funding Issues

Principals also explained how campuses rewrote policies and budgets to accommodate technology immersion. Campuses received significant grant funds to support technology acquisition and professional development. This investment included entrusting middle school students with expensive laptop computers. Consequently, administrators at many campuses believed their policies had to be updated to better communicate behavioral expectations and responsibilities to students and parents. Principals mentioned numerous issues that would affect campus policies and procedures, and place new demands on school budgets. However, they were most concerned with insuring student laptops against damage and loss, and clarifying students’ responsibilities regarding the care and use of the laptops, including appropriate use of the Internet. Almost all of the interviewed principals discussed these two issues.

Financial Liability

Insuring laptops against damage and loss was a major challenge, and campuses explored different possibilities. In fall, some sites were eagerly awaiting word from their central office about how insurance would be handled. One principal said, “They [district officials] have not shared that with us yet.” Most principals and their districts, however, had just come to realize that insurance would be an issue and were only beginning to explore their options. For example, one principal wondered, “Could we possibly ask the parents to buy the insurance, you know, like they’d do an instrument, a band instrument?” Several other principals said they had researched how other campuses dealt with insurance and policy issues. The principals and/or campus and district representatives contacted other schools that offered student laptop programs to inquire about laptop loss and damage history, insurance costs and approaches to insurance, and development of appropriate use policies. Principals also were concerned about securing and storing laptops on campus.

A few of the principals indicated that they resolved liability issues through creative financing. For example, six campuses had decided to use district or campus funds to pay for insurance, and some campuses purchased geographic tracing software as well, which allowed them to locate stolen or misplaced laptops. Four campuses required parents to pay a laptop insurance fee. One of these campuses chose to self-insure and fund repairs with parent fees. If parents could not afford the insurance, their child could participate in the school’s service learning program and work off the fee alongside Student Council members who are required to do community service. One campus chose to purchase the least expensive laptop offered, thereby decreasing future replacement costs for lost or damaged laptops.

Student Responsibility and Safety

Several principals discussed their approach to communicating laptop and Internet access responsibilities and behavioral expectations to parents as well as to students. Principals said they provided presentations, training, and letters for parents. They also provided training on the appropriate use of laptops and the Internet to students, and some principals expressed interest in establishing parent responsibilities regarding students' laptop use. Some principals worried about student safety when transporting laptops off campus. One administrator said, "How are we going to ensure that they are going to be safe taking them home?" Similarly, several technology coordinators expressed concerns with the threat of theft. For example, one coordinator rationalized, "How do you keep a computer safe in a child's arms if he's riding a bus? I'm talking about people knocking you down and taking it. How do we keep a big brother from taking it and selling it?"

Funds for One-to-One Access

Principals on some campuses faced difficulties in ensuring that all students received a laptop at campuses where grant funding was inadequate to provide a laptop for each student, or where parents could not afford a required insurance fee. One principal explained, "With the technology, then, parents could say, no, I can't afford it, so don't give my child one." Other principals were concerned about the product life of the laptops and the need to plan for replacing old or worn equipment. Some principals were considering budget implications for purchasing the technology and accessories needed to accompany the laptops, such as student access to the Internet off-campus, or additional printers and LCD projectors in the school.

Campus and/or district funds were used by several campuses to purchase the additional technology and accessories that were needed for the TIP project such as printers, LCD projectors, scanners, digital cameras and video cameras, and laptop cases and backpacks. Campuses or districts purchased laptops for students when TIP funding was inadequate to provide computers for all students on campus. One campus also provided an evening study program and transportation allowing students an opportunity to use the Internet outside the regular school day.

Additionally, some campuses began utilizing outside resources. For instance, one principal explained that the local Internet service provider agreed to provide cost-free Internet service to all students and teachers: "They're going to give them free dialup services for home for the period of the two years of the grant." The principal for another school reported that a local Internet provider planned to provide low-cost Internet services for families. Another campus reported that the Parent Teacher Association supplemented technology funding through their fund-raising efforts.

In some cases, campus representatives visited schools experienced with one-to-one laptop projects. They also took sample policies from other schools and adapted them for their own campuses. A two-day conference on one-to-one technology hosted by the Irving school district in November 2004 provided another opportunity for networking among TIP grant recipients on critical policy and implementation issues.

Accessing Vendor Support

Technology vendors played a central role in project implementation through their provision of the immersion components, so principals were asked to comment on their initial interactions with immersion package providers. Out of 19 transcribed interviews, 5 came from campuses using Apple packages, and 13 came from campuses using the Dell packages. Since only one school received support from Region 1 ESC, their comments have been excluded to protect respondents' confidentiality. Principals described prior relationships with vendors as well as communication patterns and perceptions.

Principals at campuses supported by the Apple team typically reported positive interactions with their vendors. The range of responses to Dell representatives varied widely. Some principals said that Dell representatives offered helpful responses to their concerns and questions, whereas other principals mentioned difficulties getting information, negotiating final prices, and receiving the requisite hardware and software. Overall, the descriptions of vendor relations seemed to indicate that Apple was more strongly connected to their TIP sites than Dell in the fall. This may have been due to Apple's smaller number of campuses (6 sites versus 15 for Dell), or due to Apple's relatively greater experience with one-to-one laptop initiatives compared to Dell when the project began.

Apple Campuses

Of the five interviewed principals at campuses with Apple packages, two reported prior experience with Apple. One principal said his campus had purchased computers from various manufacturers in the past, and that his campus had a relationship with Apple prior to the project. He believed the pre-existing relationship was helpful since Apple was familiar with the technology strengths and weaknesses of the campus and its faculty. Thus, they had offered strong support during the initial immersion process. The principal explained, "They know our people, they know our capabilities." A second principal reported that when teachers were asked to choose a laptop vendor, they recommended Apple because they felt Apple was more "teacher friendly" than other vendors.

All of the Apple campuses spoke positively about their communication with vendor representatives. Three of the five campuses mentioned that they received responses from Apple representatives in a timely fashion, ranging from "almost immediately" to "by the end of the day." For one campus, Apple had set up weekly teleconference sessions.

At the time of the site visits in fall, four of the Apple campuses had either completed or scheduled a portion of the requisite professional development. One principal reported that the training the campus had received already was very good. None of the Apple campuses mentioned waiting for equipment or software deliveries. In fact, one principal reported that Apple moved quickly to get technology to the campus even though the district got involved late in the TIP funding process:

> We have had our computers here in plenty of time to get everything up and rolling. We were a bit behind because we were in round two and received the notice on I believe around July 21st, so we were scrambling to get things done…Apple has moved so quickly to get us the things that we needed.

Dell Campuses

Only one of the 11 interviewed principals had worked with Dell previously (their campus computers had been acquired through Dell). Nonetheless, following the grant award, most of the principals were in direct contact with Dell representatives. At some campuses, a district administrator was the designated contact for vendor communications, while the technology coordinator was the primary contact at other campuses. The quality of communication with Dell representatives varied widely. Some principals reported that representatives were very responsive to questions and requests for information from the campus. These principals said that at least one Dell representative had already visited their campus. One principal explained, "Usually within 24 hours there was a response. They've gone above and beyond as far as contacting us as soon as we returned from our conference.

Other principals indicated that it was difficult to get through to their Dell representative by phone or email, or they were still waiting for information that was promised. Two principals specifically mentioned they had not yet received a notebook or binder with product information and pricing promised by Dell. However, one principal reported that Dell representatives provided price quotes quickly.

Overall, Dell appeared to be moderately effective in meeting campuses' initial needs. Three principals said they had to delay grant planning and implementation until they received their Notice of Grant Award (NOGA) and the district board approved it. Apparently purchase orders could not be processed by Dell without an approved NOGA. Two principals described situations where laptops did not arrive on time. In one case, the principal expected the laptops to be in students' hands at the beginning of the school year. He was disappointed that implementation would be delayed due to the late arrival of the laptops. In another case, laptops arrived after the start of the school year and it took Dell representatives some time to install software and image the machines. The immersion process was further delayed because the software that was to be installed had not been received by the campus when the Dell representatives arrived. However, once the software arrived, the Dell representatives worked through the night to image all the laptops.

When researchers conducted fall site visits, one campus had already completed some of the training provided by Co-nect (the Dell professional development provider) and reported that it was "wonderful". Five additional campuses had scheduled at least some of the professional development included in the package.

Readiness for Technology Immersion

During fall site visits, principals, technology coordinators, and teachers identified a number of potential challenges they faced in implementing technology immersion. Most campus teams had already begun communicating with their vendors and internally planning for implementation, and some campuses had received their initial shipment of laptops for teachers. Challenges to implementation centered on the adequacy of personnel, students' behavior, and teachers' technology proficiency and receptiveness.

Insufficient Capacity to Provide Technical Support

One set of issues surrounded current technical support processes and available personnel. With initial planning and research into existing technology immersion programs, technology coordinators had identified logistical issues in managing laptops. Among these were logistics in distributing, collecting, and creating maintenance processes for the laptops. One coordinator said, "The biggest challenge that I feel like I'm facing right now is to get these 236 extra laptops in the hands of the students." About a third of technology coordinators also were concerned about the amount of time needed for repair and maintenance of campus technology. For instance, several expressed these time concerns: "I think there will be a challenge with the inventory, keeping the inventory…Just the added repair, the maintenance on them. There's probably a lot more." Others were anxious about time needed for imaging and repairing damaged units. In most of these cases, coordinators felt that technical staff was already spread thin and that, without additional personnel, adequate maintenance would be difficult and, in some cases, not realistic.

Students' Irresponsibility

About a fourth of technology coordinators identified students as a source of concern. They did not believe students possessed the personal maturity and self-responsibility necessary to care for laptops. Coordinators at these campuses were fearful that students would often forget to bring their laptops to school, would lose or break the equipment, or would use the equipment inappropriately. For example, one individual said, "We're doing good to have a kid bring their own pencil, especially with these kids here. Our teacher usually has pencils here available because the students say, 'I forgot it'." A coordinator in a different district explained further:

> Are they going to be responsible with these computers? I mean I'm fixing to give them this $1,200-$1,300 computer, and we have an issue that some of them can't bring a book to class. So

> are they going to remember? Are they going to remember to charge it? You can see the hall is very crowded. You know, maybe dropping it or leaving it somewhere.

Of course, students' irresponsible behavior would entail additional work on the part of the technology crew, and from an educational standpoint, reduce learning time.

Teachers' Limited Technology Proficiency

Technology coordinators at more than half of the campuses shared concerns that technology immersion would be affected by existing low levels of teacher proficiency with instructional technology. As might be expected, the coordinators also linked teacher proficiency to their attitudes and levels of comfort in using instructional technology. One coordinator reflected:

> Truthfully, the biggest issue I have right now is the teachers who are just…'I've done my teaching this way for 20 years. I don't want to change. Thank you, but no.' But, if they're going to be teaching under this grant, then they have to change. It's going to come quicker than what they are ready for.

Teachers also worried about their own level of technology proficiency and experience with technology integration. Many feared they would fail their students, who would be unable to take full advantage of the technology opportunities. A teacher said:

> I'm nervous because I've never integrated computers, especially where everyone has a computer. And, if you guys are going to invest that much money into it, I want to get the most out of it for my students and that's what I'm afraid of…That I won't utilize it to its potential.

Some principals attributed teachers' technology anxiety to a generational divide. Principals noted that veteran teachers were less technology savvy and more skeptical or fearful of TIP, but younger teachers were more open-minded and excited about the project. One principal explained, "We have teachers on our campus that are still not really comfortable working with technology in the classroom…You know as well as I do, if you're not comfortable with it, you're not going to use it."

Technology coordinators cited the need for professional development opportunities throughout the year as well as one-on-one support for some, less proficient teachers. For the most part, coordinators did not believe teachers' lack of proficiency was an insurmountable barrier.

Teachers' Commitment to Technology Immersion

Enthusiasm Tempered with Anxiety

Sixth-grade teachers expressed a mix of enthusiasm and anxiety relative to the immersion project. Nearly all teachers felt fortunate to participate but still worried that the implementation process would be very difficult. Both principals and teachers said most teachers were receptive or enthusiastic about the project. Teachers at *only* one campus voiced a highly negative attitude towards the grant. These teachers viewed TIP as an additional set of challenges, without seeing any benefit derived from grant participation. One sixth-grade teacher voiced her concern: "I will tell you right now, until I get some concrete information on how we are going to manage this, they [the laptops] will not come in my room." The campus principal portrayed teachers' attitudes in a more positive light, saying that they felt "guarded excitement…They see the opportunities, but they also see struggles they are going to go through."

Teachers were mostly apprehensive about the time and extra work involved in TIP participation. In addition, some teachers seemed nervous about using new technology. Teachers also feared the unknown. Because implementation plans were not finalized, teachers were uncertain about their grant roles.

Concerns with the Increased Work Load

Some teachers worried that the time and work involved in TIP implementation would place too many demands on their already-busy schedules. One teacher explained:

> I'm not ready for the computers, yet. I mean I like the idea and I'm all for it, but my curriculum's not there yet. It's going to take a lot of work on my part to develop all that. That kind of inhibits me from being super excited. It sounds really cool and I know the kids are excited, but I'm thinking, 'Wow. How much time am I going to have to develop these lessons and dedicate to preparing for this.'

Despite the hardships and concerns, many teachers said they were willing to put in the hours necessary to make technology immersion successful.

Confusion and Uncertainty about Immersion

In fall, before most campuses began implementation, many teachers seemed confused and uncertain about how technology immersion would work in practice. Representatives from some schools were particularly concerned about the implementation process. One teacher said:

> It seems overwhelming at first...until we know more what's to be expected. I keep thinking timelines of certain, 'We've got to get the kids to use this by this date, and get them exposed to this by this date.' I'm not sure if we're already supposed to come up with projects that the kids do. It's still a little fuzzy. I know we're getting the laptops, kids are going to have access to them, we're going to have them in the room, they're going to be able to use them anytime, we're getting training. But as far as when we need to have certain things done, we're still in the dark.

Expected Outcomes of Technology Immersion

Teachers' Anticipated Benefits for Students

Teachers' enthusiasm for immersion most often stemmed from their perceived benefits of the grant for students, such as *increasing motivation*, *individualizing instruction*, *enhancing technology skills*, and *decreasing the technology equity gap*. Many teachers believed that technology immersion would increase student motivation and improve academic performance. For instance, one teacher commented:

> I'm looking forward to the idea of trying to do something other than worksheets on our computer, to try to get the creative juices flowing from the kids so that they can use their minds and come up with the answers instead of being spoon fed everything.

Several teachers pointed to increased opportunities for differentiated instruction, since laptops would enable students to work at their own pace. Both talented and gifted and special education students could benefit from differentiated learning. One teacher explained:

> For the youngsters that work fast and do their work well, which would probably be classified as the gifted and talented, I think that this will be exciting for them. The students taking time to read their AR book, which she may not want to have happen, they'll have a chance to follow-up and learn things on their own that we never touch.

Some teachers also believed that students would benefit from the technology skills, such as Internet research, word processing and other software, they would learn as a result of TIP. These marketable skills, some of the teachers said, would ultimately help students in the workforce. One teacher said:

> I think we're going to make them more marketable when they finally do get out of the school system. I think that's something we lack here is getting the kids ready because of the lack of computer usage.

One teacher commented, “Well I think it’s wonderful especially for the students that we have on campus that do not have computers at home, can not afford computers at home, and it’s opened up a new world for these kids.” Teachers at schools serving primarily low-income students also identified increased equity as one of the anticipated gains from TIP:

> They already have so many disadvantages, and if these children were growing up in another neighborhood, they would not have these disadvantages, so I think anything that helps give them a little boost up, it has got to be a good thing. Even if it is not 100% successful, it has got to help them.

Principals' Anticipated Benefits for Students, Teachers, and Schools

Despite acknowledged difficulties with project initiation, principals expressed hopeful expectations for technology immersion. Principals sometimes spoke about their aspirations for the school as well as expectations for teachers’ enhanced skills and instruction—however, similar to teachers, they most often cited anticipated improvements for students. Although expected changes in teachers varied across interviews, principals had fairly similar goals for students.

Students

Principals frequently cited benefits for their students, including *increased achievement, relevant and engaging learning experiences, increased technology proficiency,* and *more equitable access to technology*. Foremost, many principals voiced hopes for higher student achievement and improved outcomes in general. Principals cited improved TAKS scores as one desired outcome. They thought technology would increase achievement in several ways. For instance, some principals thought the use of technology could help students develop better cognitive skills through “problem-solving and inquiry-based learning” and “higher-level learning.” One principal explained:

> With a computer, when you go into the Internet, and you’re researching, and you’re being able to do sites that are multimedia, it’s much more of a problem-solving approach than having a teacher sit there and read from a book, or do direct teaching.

Principals also expected changes in student learning opportunities. For example, they expected students to use their laptops for research projects, homework, emailing questions to teachers, and tutorials with extra help in difficult subjects. In addition, principals believed the greater independence allowed by laptops would make learning more student-centered.

> I want to empower the students to take responsibility for their own learning, and I can see this through the use of technology. If we’re not exposing the students to self-discovery—that’s basically one of my goals—to change the role of teaching.

Principals also talked about their students taking more “ownership” of their learning with increased technology, and the teacher becoming a facilitator. One envisioned a “community of learners:”

> My hope is that the kids will become more involved in their own learning process. Instead of the teachers doing all of the teaching, the kids will be learning how to access information, which I believe is what our world is all about right now. By doing that, they will be becoming teachers and mentors for each other, as well as the teacher will be learning along with them. So the school will actually become a community of learners, and that’s our whole goal.

Some principals believed that technology, rather than traditional instructional methods, better suits today’s students who are accustomed to “interactive, digital types of input” and are bored by traditional teaching methods. Consequently, principals predicted that students would spend more time on-task and be more engaged. “It’s going to cause excitement in the instruction and student learning…They really want

to go in there and be able to type up their reports. They want to be able to research topics that they've been given. There's excitement there."

Several principals suggested that technology might increase student engagement, which in turn, would improve achievement. One commented:

> A lot of the students are not necessarily "bad students," they are not doing anything wrong. They just are not really in tune to what is going on here and traditional methods of teaching just do not click for them. That is my biggest hope is that I do not think computers are going to make anybody any smarter than they are. What they are going to do, I hope, is engage students so they will want to learn, and that is more than half the battle.

Many principals expected students to become proficient users of technology. Some regretted that students would be unable to take the laptops with them to high school, but they still believed that the technology skills gained from TIP would help students in high school and college. Nearly all principals expected the project to make students more competitive in the job market. They noted that technical/computer proficiency is essential to success in the 21st century, so immersion was giving these students a leg up. Immersion also was viewed as a means to achieve educational equity. Several principals saw TIP as a way to level the playing field for students from low socio-economic backgrounds.

> We've got some kids that have some really great gray matter, they just haven't had the opportunity to develop it or the tools they needed to get out there. And this is what I've told my staff and this is what I tell my kids. I want every drop you've got. We're 90% economically disadvantaged. If they get the tools, they can get their college paid for.

Principals also mentioned other anticipated changes in students. Several expected attendance to improve. Some thought TIP would make students happier to be in school, resulting in fewer absences, less tardiness, and fewer dropouts. Likewise, a few principals expected fewer discipline problems due to higher engagement in the classroom. On the whole, many principals connected technology immersion with greater student motivation, engagement, and morale, and hoped that the project would help raise student achievement levels.

Teachers

Several principals expected technology immersion to improve teacher *proficiency with technology* and lead to *changes in their instructional approach*. Principals frequently noted teacher discomfort with the laptops and software, and they believed training and exposure would help teachers become more technology literate so that teachers would embrace technology and fully integrate it into the curriculum. Other principals expected changes in teachers' instructional methods. Many hoped that teachers would integrate technology into the classroom and change their teaching style by moving away from what one principal called, "traditional, ritualistic learning."

> A big change in instruction is gong to be the method in which it is delivered…The teachers are always going to be guiding the students through whatever it is they're working on, but it's definitely not going to be the traditional teacher standing in front of the classroom lecturing while students take notes.

Principals expected teachers to use textbooks less and to use online resources, such as websites with lesson plans and new teaching ideas more. One principal thought technology would help "break the mold" for teachers who have been teaching the same lesson plan for years. For some, this meant an expectation that instruction would become less "teacher-directed" and more focused on small-group, hands-on, and research activities with the teacher as "facilitator." One principal expected differentiated instruction, with students working independently and at their own pace:

> We're interested in differentiation of instruction for all learners. The neat thing about this, and what we recognize in technology and laptops, is an immersed environment has the capability to provide differentiation almost automatically.

And, individualized learning was viewed as a way for struggling students to catch up and strong students to pursue their own intellectual interests beyond the confines of the class/curriculum.

Schools

Although school-level expectations varied, several principals mentioned new opportunities for *technology leadership, improved communication,* and *enhanced parent involvement*. Some principals hoped to become a "pioneer school as to how one-to-one computing works" or a leader in the district, region, state, or nation in the area of technology immersion. One principal envisioned "vertical immersion," with technology seamlessly integrated into elementary, middle, and high schools: "Our goal is that our sixth graders that go to eighth grade…up into high school will take their laptops or get another laptop." Another hoped TIP would help students and families value education.

Some principals also expected changes in communication patterns, and thought TIP would increase the volume of communication between teachers, students, and parents. For example, one principal said the school was transitioning to email for staff and student announcements and encouraging teachers to use web pages to post events and announcements. Likewise, a few principals anticipated changes in parent involvement and influence. Three principals hoped to provide computer training for parents. Other campus administrators hoped TIP would increase parent involvement by enabling them to view class assignments online, check student homework, or communicate with parents through email. One principal hoped that training would allow teachers to…"reach out not just in school, but to the home so that the parents and the children are better aware of what is going on in this building."

5. Technology Immersion Pilot—First-Year Implementation

Between March and May 2005, researchers conducted follow-up site visits to each of the 22 Technology Immersion Pilot (TIP) campuses in order to gather information on project implementation. Researchers assessed the extent to which schools implemented the grant-specified components of technology immersion and identified barriers that slowed their progress. In addition, researchers investigated how teachers and students used laptops and their digital resources and gauged the perceptions of administrators, teachers, and student relative to the value and effects of technology immersion.

This chapter's findings combine information collected from a variety of sources, including individual interviews with principals, technology coordinators, and district administrators as well as separate focused discussions with groups of sixth-grade teachers of core-content areas (6 to 8) and randomly selected groups of sixth graders (6 to 8). District representatives, selected because of their direct involvement in the project, tended to vary across campuses and included superintendents, assistant superintendents, and district technology coordinators. Researchers tape-recorded all interviews and group discussions and analyzed transcripts using qualitative methodologies. During site visits, campus-level technology coordinators completed a technology inventory that provided further quantitative information on each campus' level of access to technology and technical support for immersion. In addition to data collected on site, researchers also examined grant, campus, and vendor documents, and in fall 2005, conducted small group interviews with vendor representatives.

Implementation of Immersion Components

The technology immersion model assumes that effective technology use in schools and classrooms requires robust access to technology, technical and pedagogical support for implementation, professional development to support teachers' effective classroom use of technology, and readily available curricular and assessment resources to support the state's curriculum in the core subjects (English language arts, mathematics, science, and social studies). Through a competitive process, the TEA selected three vendors (Apple, Dell, and Region 1 ESC) as providers of technology immersion packages including grant-specified components. Of the 22 immersion sites, 6 middle schools selected the Apple package, 15 selected the Dell package, and 1 selected the Region 1 ESC package. (See Section 4 for a description of packages.) The sections that follow discuss campuses' progress in implementing the four key components of immersion.

Robust Access to Technology

All technology immersion packages provided wireless laptops and productivity software for teachers and students. Campuses with Apple laptops received AppleWorks, a comprehensive suite of productivity tools. For Dell and Region 1 ESC campuses, Dell laptops had Microsoft Office productivity tools, and eChalk served as a portal to other web-based applications and resources in the immersion packages. The TIP grants did not provide funds for wireless infrastructure or Internet services, so districts and campuses used local resources to build an infrastructure to support technology access. In the sections below, robust access is described relative to the nature of technology access inside and outside of schools and the health of middle schools' technology infrastructure.

Access at School

Laptop rollout. Most campuses distributed laptops to students at kick-off events, or rollouts, attended by district representatives, teachers, parents, students, and community members. Rollouts generally included an orientation to the project and presentations informing parents and students of appropriate use policies, insurance requirements, and laptop care.

Delayed rollouts. Because of logistical procedures in the awarding of two rounds of grant funds, most campuses had later than anticipated rollouts. As shown in Table 5.1, most campuses received teacher and student laptops between October and December of 2004, and for some campuses, rollouts did not occur until January or February of 2005. Delays meant that students had laptops for an average of 105 days, or about 60 percent of the 180-day school year. Many teachers did not have laptops for some early professional development activities and had little lead time to get comfortable with their laptops before students received computers.

Table 5.1 Teacher and Student Rollouts by Month

Month and Year	Number of Campus Distributing Teacher Laptops	Number of Campuses Distributing Student Laptops	Average Number of Student Days with Laptops
August 2004[a]	3	0	0.0
September	3	0	0.0
October	5	5	137.8
November	6	6	114.2
December	2	2	105.0
January 2005	3	8	87.5
February	0	1	72.0
Total/Average	22	22	105.1

[a] Teachers at two campuses acquired laptops through another funding source in April to June 2004.

While most rollout delays resulted from the timing of grant funding, others resulted from difficulties in relationships with vendors (5), campus-level planning (3), and parental resistance (2). In terms of vendor-related problems, one campus disputed vendor pricing and another received an incorrect device for all of its laptops. One district-level technology coordinator described the confusion in his district:

> It was a real mess. The whole process of acquisition, setup, installation of all of the computers was just absolutely chaos, to be charitable. There were delivery snafus. We asked for support from our preferred vendor, and of course contractually, they couldn't work with [the TIP vendor], so the people they brought in weren't as efficient.

Campus-level delays were generally related to planning. One school struggled to rewrite its acceptable use policy before releasing computers to students, another postponed rollout until it could purchase computer carts for laptop storage, and another waited to clarify confusion over data loading issues before distributing laptops.

Two campuses could not complete laptop rollouts because significant numbers of parents refused to sign user agreements. One school provided loaner laptops for in-school use for students of such parents, and the other permitted students to use classroom or library computers.

Parental support. Rollout activities provided both an opportunity and need for parent involvement, since parents had to shoulder responsibility for laptops along with their children. One principal reported that teachers were astounded when the TIP kick-off drew unusually high attendance levels from a group of parents who generally ignored school functions. On another campus, TIP parent

meetings were "standing room only" events. For both schools, the high attendance rates reflected parents' enthusiasm for the laptop program. In contrast, nearly a third of TIP campuses struggled to gain complete parent support. A principal on one such campus explained, "[Some parents] looked at the negatives rather than the positives…They felt like 'Oh, my child is going to be exposed to the evils of the world out there."

Parents on another campus worried that they would be stuck paying the costs of broken or lost laptops. The principal explained how the district addressed concerns:

> We had lots of parent meetings, not just at [school name]…The board talked about it, our school board. We brought in interpreters for our Hispanic community, and if the parents, even after the big meetings, were still uncomfortable, I had little mini-sessions with them to answer their one-on-one questions.

The problem for some parents was the $50 cost of insuring students' laptops. But even after the school arranged a scholarship fund to cover fees for low-income families, some parents would not approve their child's participation.

Initial challenges. Principals made several suggestions for improving technology immersion start-up. Nine principals emphasized the need for greater communication with parents, stressing the need to ease parent concerns and instruct parents in monitoring laptop care and use at home. Principals also underscored the need for clear rules guiding student use before laptops are distributed. Acceptable use policies and the consequences of infractions were a central consideration, but administrators also needed to address less obvious details such as guidelines for screen saver images and whether laptops could be stored in lockers.

Many technology coordinators said that incomplete loading of laptop software impeded start-up. More than half of campuses (12) received laptops that had not been fully imaged (all software was not loaded). In most cases, computers needed to be "ghosted" or wiped clean and then have all software re-installed, which required a substantial commitment of staff time and energy. "It took six people one full day to image," explained one technology coordinator. On another campus, imaging needed to be done twice, and another schools' laptops needed to be re-imaged when it discovered that its hardware vendor had installed a "popup ad that made all the computers freeze up." In order to accelerate the re-imaging process, some campuses purchased network management software, such as Remote Scope.

Access Outside of School

The TIP vision for technology immersion requires that students have ubiquitous access to technology, which includes access to laptops at home. This provision in the TIP grant generated resistance at some immersion campuses. During first-year implementation, six campuses limited students to in-school use of laptops and two campuses allowed laptops to go home only for special assignments. Even when students were permitted to take laptops home, access to online resources often was limited because many students did not have Internet access at home. In some communities, however, students could access the Internet through local "hot spots." These spots were located near libraries, churches, a chamber of commerce, or on tables or tennis courts on school property. Some schools extended students' access to school facilities in order to extend their Internet access during non-school hours. One school set up a weekly schedule of access times, and others opened their campuses, permitting students access to the building before the first morning bell or after classes let out in the afternoon.

Infrastructure for Immersion

During site visits, nearly a third of principals said that their buildings did not support the infrastructure demands of TIP. A principal whose school was built in the 1930s explained:

> Our main problem is that we are in a building that was built at a time—and wired at a time—that there was no concept of what we're doing today. I feel that a lot of our problems could be resolved if we had a more modern facility.

Three interrelated elements of infrastructure—hardware, network, and software—are discussed in the following sections.

Hardware maintenance. During interviews, many principals, campus-level technology coordinators and district representatives described hardware issues that affected implementation, and technology inventories for half of campuses indicated that hardware repairs could not be completed the same day problems were reported. Laptop storage, security, and insurance were also concerns.

Minor hardware issues. Minor hardware problems included missing keys, scratched monitors, and defective chargers and batteries. Related issues included poor quality computer carrying cases, misplaced AC adapters and detachable floppy drives, and dusty or dirty laptops (10 campuses).

Major hardware issues. More serious hardware issues included broken or cracked monitors, bad motherboards, broken keyboards, and damage caused by student misuse (8 campuses). These problems frequently required considerable time to repair or laptop replacement. Some campuses provided students with loaner laptops during periods of extended repair, but other schools required that students share laptops or use classroom or library computers.

Hardware storage and security. Many campuses (18) did not anticipate the need to provide secure storage for laptops during school breaks. As one district-level administrator explained, "If we could have put security measures in the grant beforehand, if the grant would have required us to identify, '…what steps are you going to take to ensure physical security of the equipment, and what steps for long-term storage?' that would have helped us think through those processes." Some campuses also struggled to provide security for laptops when they were in students' hands. At least two campuses reported lost or stolen laptops during the course of first-year implementation.

Insurance. The need to secure computers prompted most campuses to obtain insurance policies covering laptop replacement costs. However, attempts to share insurance costs with parents created some challenges. On one campus, some parents refused to pay a $50 insurance fee, but on another, all parents were able to pay $25 to cover laptop insurance costs. In order to help low-income parents with insurance expenses, another campus organized a sponsorship program, and another district wrote an additional grant to cover insurance expenses for all parents.

Network. In addition to hardware issues, many campuses experienced network limitations that frustrated their efforts at immersion. In most cases, problems were related to poor Internet connections caused by insufficient bandwidth. More than half of technology coordinators (13) said the network failures, slow connections, and bandwidth logjams were persistent problems on their campuses.

Some campuses experienced connectivity problems because district servers were insufficient for the demands of TIP or were subject to district-level management decisions. "We are having server problems," said one technology coordinator, "Sometimes the district will turn it off and we don't know about it. Sometimes it goes off for more than one week at a time." On other campuses, problems

resulted because T-1 lines[1] were shared with other district schools, resulting in frequent bandwidth logjams. “If 24 students try to get on, some get bumped off,” explained one technology coordinator.

Although some campuses recognized infrastructure limitations early in the process of planning for TIP, lack of expertise prevented them from effectively addressing problems. In order to enable greater Internet access, several technology coordinators said that districts were planning to add bandwidth in the future.

Software. Nearly all technology coordinators reported that software issues, such as forgotten passwords, inadequate Internet filters, and viruses hampered first-year implementation, although most coordinators’ were able to remedy problems within a day or so.

Passwords and settings. Forgotten passwords were a persistent and time consuming issue across immersion campuses (9). Because most laptop resources required unique passwords, students and teachers were challenged to remember multiple passwords in order to access programs. In an attempt to reduce time spent recovering and resetting passwords, one technology vendor developed a form on which students and teachers could record their passwords. Students’ ability to access laptop settings also caused problems for some campuses. “All the kids get in and mess with the settings. They lock the machines.” said one technology coordinator. “Students go in and reconfigure things,” said a coordinator on another campus, “We wanted to lock students out of settings, but to do so would require re-imaging all computers.” On another campus, students registered as administrators during the initial laptop set up which permitted them broad access to laptop settings and controls until school administrators discovered the problem and reset the computers.

Inadequate Internet filters. About half of principals (10) said that students were able to bypass school filters and access inappropriate websites. The technology coordinator for one campus said, “It’s amazing how students can locate unacceptable websites even though you think you have everything covered.” In some instances, students stumbled onto inappropriate sites during legitimate searches, but some students deliberately accessed inappropriate sites through the use of Spanish search terms (filters work in English) or through tricks that disabled filter screens. On another campus, however, filters worked so well that they restricted students’ access to package resources.

Viruses. Only three technology coordinators mentioned viruses when discussing software problems and each said they were able resolve problems by updating their anti-virus software. One technology coordinator noted that virus problems increased when the school permitted students to use dialup Internet connections at home.

Overall, robust access to technology was limited in the first year by a number of factors. The TIP grant timeline and budgeting process caused initial delays in the distribution of laptops, and further delays resulted from relationships with new vendors, poor campus-level planning, and parental resistance to insurance fees. Once laptops were distributed, technology coordinators and school administrators confronted a variety of problems that limited access to technology. Infrastructure problems posed substantial problems for schools housed in older facilities, and network issues, in varying forms, troubled most campuses. Because many of these issues were unforeseen, school administrators and technology coordinators frequently made ad hoc decisions rather than following a prescribed course of action in resolving problems.

[1] A leased telephone connection used by businesses and schools to enable more individuals to access the Internet.

Technical and Pedagogical Support

The TIP grant requires that technology vendors and recipient districts provide comprehensive technical and pedagogical support for technology immersion. Each vendor-provided technology package included a professional development component designed to support teachers' use of technology in the classroom as well as technical support services offered through call centers, online help desks, and on-site assistance. The following sections discuss technical support provided by districts, campuses, and vendors as well as district- and campus-provided pedagogical support. Because vendor-provided professional development comprises such a large portion of the overall vision for TIP, absorbing 25 percent of all grant monies, its discussion is reserved for the professional development section that follows.

Technical Support for Immersion

District- and campus-provided technical support. As noted above, districts were required to provide dedicated technical support for campuses as part of their participation in TIP. To this end, each campus identified a campus technology coordinator to provide technical assistance for teachers and students, and in many districts, additional support was available from district-level technology staff. The level of district-provided technical and pedagogical support and the position of campus-level technology coordinator, however, varied widely across immersion campuses during first-year implementation. In some schools, the campus technology coordinator was a full-time position, but in others, it was a part-time position or a split-time arrangement that carried traditional teaching or administrative duties.

Providing technical support. Technology coordinators reported that they provided technical support for a wide range of issues, including managing the distribution and collection of computers, imaging laptops, solving printer problems, addressing log on and password problems, missing keys, broken motherboards, and so on. One tech coordinator described his role:

> …what my job is, is to make sure that the teachers have support, whether it's hardware, software, integration, whatever areas that they have questions or problems concerning the laptops, then I'm there to try to make sure that everything gets fixed and running and that they understand how to use it. So we take some staff development time to do that with groups, but then also individually, they may email me and say, "You know what? This isn't working, or I don't know how to do this, or I can't get this print," and those kinds of things, and we do that just one-on-one.

Many technology coordinators, however, did not have backgrounds to provide broad-based technical support directly. "I can do basic troubleshooting," explained one coordinator, "I am not an expert at the repair." Many coordinators said that they relied heavily on district- or campus-level technicians, and in some cases, on teachers with technical expertise to assist with more challenging problems. A technology coordinator described the sequence of obtaining technical support for her campus:

> If it's a technical problem with the computer, if I can quickly figure out what the problem is and resolve it, then I will. If I can't, this table we're using right now is where you put computers that have problems. And then [district] technicians, over a period of time, will come in, or I'll call them. They say they'll come that day, and if it doesn't have to be ordered from [the vendor]—if it's something that they can fix immediately—a student usually has it back in their hands in two days. Maybe that day, you know, it could be less. It just depends on the problem. Of course, what you have got to realize is those two technicians are working for other campuses, too.

Recognizing that reliance on district-level technicians slowed the process of technical support, five principals expressed the need for campus-level technicians.

Shifting expectations about the job. Many campus-level technology coordinators said that their expectations about their positions changed over the course of the first-year implementation. Several coordinators said they expected to spend more time supporting teachers' efforts in classrooms and curricular integration, but that responsibilities for technical support and management tasks consumed most of their time. One technology coordinator explained:

> What I thought was going to be my role has not been my role. My role has become one of technology support. That's pretty much all I do is technology support, including email, troubleshooting, the hardware, software type stuff…I have definitely tried to get teachers' classes up and running for them, showing them how to navigate those sites.

A technology coordinator in another district shared a similar view:

> I envisioned my job being very much programmatic and having the time to go and look in on classrooms and help co-teach. I've found that that is a near impossibility when you're talking about all of the aspects to the grant—not just the grant—the immersion process. I mean, you've got the online learning resources, scheduling the training for them, prepping the materials for the parent training night, how we get them ready, how we get them translated into Spanish, you know? All of that consumes a great deal of time, and then insurance policies and filing the claims, and all kinds of fun things.

"I have not done any curriculum," said another coordinator, "I have done more with just the secretarial work part of it in getting forms and all that kind of stuff has taken some time." And in still another district, the coordinator explained, "I felt like I got caught up in the logistics where I wasn't with the teachers. Right now, I'm still not there for the teachers in the aspect of helping them integrate, but they've come a long way on their own."

Sense of being overwhelmed. In addition to re-definition of their roles, nearly half of technology coordinators reported that they were overwhelmed by the scope of their responsibilities. Burdensome administrative tasks, such as hand entering computer serial numbers into district databases, and responding to myriad teacher requests for technical support weighed heavily on some coordinators. "It's a job that continues to change each and every week," explained one coordinator, "It's demanding in terms of a diversity of issues." "It's just a lot of extra work. I don't know how else to say it," said another. "I feel quite overwhelmed," said still another, "…the district has supplied a clerk that helps… but still it's such a very big job for both of us." Teachers expressed sensitivity to the demands of the technology coordinators' position, noting that coordinators "worked their tails off" or as one set of teachers explained, "We all need to pitch in and pay for some counseling for [technology coordinator] because I think when summer gets here, she's going to crash because she has been busy, busy."

Many coordinators had little or no previous experience working with a wireless network or in administering a broad-based technology program and said that the position's pressures could be relieved through training. "There were network issues we didn't know about," explained one coordinator, "[the school network] had to be configured to the new access points. The rollout staff should have been invited to the TIP summer institute [training]."

Vendor-provided technical support. Technology coordinators reported that they generally sought vendor support only after exhausting campus- and/or district-level avenues to resolving technical problems. A technology coordinator described the process:

> I try to resolve the concern first. Then, if it's something I can't handle, then I take it to [district technician]. Of course, if it's something that needs further attention, then we, of course, send it [to vendor].

Although few technology coordinators spoke of the need to use vendors' technical support services, those that did, generally reported satisfaction with help they received. Three technology coordinators who spoke of sending laptops to vendors for repairs said that service was completed quickly.

Technology coordinators' views of vendor-provided technical support offered by telephone or through online help desks varied. Apple established a support website and call center devoted to the needs of TIP. "If I call I can get through easily," said a technology coordinator who had used the service, "They have a special…website you can go to and it addresses specific issues with the TIP grant." Initially, Dell routed calls to an outsourced help site, which frustrated one coordinator who encountered language barriers, "I don't know what country it was in, but she didn't speak East Texan and I didn't speak whatever she was speaking. So that took 40 or 50 minutes just to tell her I had a bad keyboard." After encountering initial problems with their technical support, Dell reorganized its support services to include weekly customer calls, a central website for TIP school communication, and a dedicated TIP call center. Additionally, Dell allowed one individual in each district to become a "certified technician." Certification allowed districts to order parts directly and facilitated greater self-servicing and efficiency.

Pedagogical Support for Immersion

As a means to support teachers' classroom technology integration, the TIP grant required districts to provide dedicated pedagogical support for technology integration. This responsibility was typically assigned to technology coordinators, who, as the previous section makes clear, were often unable to perform pedagogical support tasks because technical support and administrative duties absorbed the bulk of their time. Although competing responsibilities prevented many technology coordinators from fully providing pedagogical support, some districts managed to structure systems of support that complemented vendor-provided professional development with district- and/or campus-level training for technology integration.

District-level pedagogical support. Technology coordinators on six campuses said that in addition to vendor-provided training, they relied on district-level staff to provide teachers with support for integration. In some instances, support was provided in the form of technology workshops offered during summer months or on weekends, and in other cases, district-level staff scheduled regular campus visits to provide assistance for integration. One technology coordinator explained:

> [The district-level support person] is on campus two days a week, and I'd guess, for me, that would be who I'd have to go to or do go to…That time is needed to find good websites. She's emailed me several of those. She knows everything. She can help you find your password, remind you to do things, give you websites.

A technology coordinator on another campus in a large district said that although the district was aware of its responsibility to provide pedagogical support for immersion, the obligation was of low priority, "The district is pretty busy right now going through restructuring, and so [pedagogical support] just got kind of pushed to the side."

Campus-level pedagogical support. About half of campuses supported vendor-provided professional development with follow-up and review sessions offered by campus-based technology coordinators. On such campuses, technology coordinators reviewed the use of package tools, such as eChalk and MovieMaker, and instructed teachers on acceptable use policies, creating Web sites, classroom integration techniques, WebQuests, as well as the use of scanners and LCD projectors.

Nine technology coordinators said they provided follow up to vendor-provided training only when teachers specifically requested help. One technology coordinator explained:

> [Vendors have] done a good job as far as that training is concerned. Any kind of specific instructional problem, the teachers involved have come to see me, and we have talked about it, and we have talked to the other teachers about it or I have called various other places to see if they have the same kind of situation and how they handled it.

On another campus, the technology coordinator, who also had teaching responsibilities, described the difficulty of finding time to assist teachers:

> If they ask me how to do [something] with the computer—how to integrate or something—I'll take the time to show them. But teaching half a day and so on, I just really don't have the time.

Another technology coordinator provided teachers needing assistance with written materials, and on another campus, the coordinator scheduled monthly meetings to discuss problems and share ideas with teachers. Several technology coordinators said that they provided support for basic computer skills rather than for classroom integration. They explained that basic support was needed because many teachers lacked fundamental technology skills and were not yet ready to integrate computers in classroom instruction.

No formal district- or campus-level pedagogical support. Technology coordinators and teachers on several campuses said that there was no formal system for the provision of instructional support at either the district or the campus level. These campuses relied solely on vendor-provided professional development and teacher collaboration to support classroom integration.

Teacher-provided pedagogical support. Across immersion campuses, teachers said that they relied on each other for ideas and help with technology integration. This support was sometimes provided through formal structures such as grade, subject area, or team meetings. Teachers in one focus group said:

> This is a cooperative group here. We help each other if other teachers are more advanced in technology. All the teachers will get together for team meetings, and that's where we'll get all that information.

And in other instances, teachers said they supported each other through informal interactions, "We're all good friends, and we all help each other. Anybody on this team, I think, can ask anybody on this team anything and know that they're going to get help and support." Teachers on another campus said they frequently discussed technology integration during lunch and expressed a desire for more full-staff meetings to discuss TIP issues. Teachers on three campuses wished for a common grade-level or subject-area planning period in order to facilitate the sharing of integration ideas and to coordinate lesson planning with other teachers.

In sum, technology coordinators typically relied on campus- or district-level technical support before turning to vendors. While district-provided support generally was effective, the pace was sometimes slow when provided by district technicians because these individuals were responsible for technical support to other campuses. Coordinators generally sought vendor support for problems that were covered by warranties or for issues that district technicians were unable to repair. Technology coordinators said vendor repairs were completed quickly and to their satisfaction.

Pedagogical support for immersion generally failed to reach expected levels in the first year. Many technology coordinators were overwhelmed by the administrative and technical support aspects of their positions and were unable to assist teachers with classroom integration. In the absence of campus-based pedagogical support, teachers often looked to one another for help integrating technology into classroom practice.

Professional Development

As noted in the previous section vendor-provided professional development is an integral component of the TIP project. Underscoring the importance of teacher training in the immersion process, the TIP grant requires that campuses use 25 percent of their grant funds to purchase professional development services designed to support classroom integration of technology. The project's Request for Qualifications (RFQ) from vendors establishes the purpose of TIP professional development:

> Professional development grounded in sound learning theory that emphasizes technology integration into the teaching and learning process will allow educators to create technology-enhanced learning environments and experiences that positively impact student academic achievement.

The RFQ further required that professional development must prepare teachers to align technology-based instruction with standards-based lesson plans, facilitate the development of "peer-to-peer learning and support communities," and enable core-content teachers to effectively integrate technology into classroom instruction. As noted earlier, the TEA selected three vendors to provide comprehensive technology packages, including professional development, to immersion campuses: Dell, Apple, and Region 1 ESC. Table 5.2 lists the elements and their descriptions included in each vendor's printed materials for their professional development component.

Table 5.2. TIP Professional Development Models and Components

Apple Model
Getting Started, Pt 1 : Discovery (understand school needs, goals, capabilities); Teacher laptop distribution/basic skills
Getting Started Pt 2*:* Student roll out (being productive from the start, appropriate use)
Digital Literacy Pt 1*:* Summer institute to learn how to use curriculum resources, productivity and media tools, plan classroom activities.
Digital Literacy Pt 2: Teachers learn how to use curriculum and assessment solutions; Work with teachers as they implement activities in their classrooms; Work with teachers to use data to plan teaching and learning activities
Maximizing Student Achievement: Teachers rethink the ways they ask students to engage with content; teachers design and implement standards-based, technology-supported lessons/units; teachers design learning environments to promote higher order thinking and critical problem solving in content areas.
Specialized Services:
Classroom-based Modeling*:* Consultants present demonstration lessons in actual classrooms, with opportunity to observe and debrief technology lessons; Consultants with teachers to implement previously designed lessons.
Online Learning Community. Online assistance and ongoing support between or after workshops.
Dell (Co-nect) Model
Setting the Stage: Vision for technology integration, introduction to notebook computer, eChalk as a Portal to all of your resources, Integrating the notebook computer into the classroom (6 hours total)
Assessment: Introduction to online formative assessment tool, using assessment outcomes to make informed data decisions (5 hours)
Standards-based Instruction: Using netTrekker to integrate online instructional resources, student curriculum resources with Connected Tech, Introduction to study groups and online professional development (7 hours)
Services Throughout the Year:
Collaborative Study Group: Teachers, grouped by subject area, participate in study groups during the year on the implementation of technology-rich lessons.
Integration of Technology into Standards-based Lessons: Providing remote support for study groups; facilitating group sessions including lesson planning and reflection on lesson outcomes.
Coaching: Co-teaching/classroom coaching during implementation of standards-based lessons that integrate new technologies; assistance with lessons; ongoing phone and email support.
Region 1 ESC Model
Technical Components: Teachers receive training on eChalk, Connected Tech, and i-Know.
Connected Coaching: During initial implementation, one mentor for every 7 teachers on campus 3 days a week for 3 weeks. Technology Integration specialist will be on-site to provide professional development related to integration of key research resources throughout the year.
Connected University: Teachers access online training through Connected University. Selection of courses determined by the campus or self-selected.

There are few notable differences in the types of professional development services offered. Each vendor proposed to begin training with introductory sessions designed to highlight the potential of one-to-one technology in the classroom and to familiarize teachers with the components of wireless laptops. Subsequent trainings focused on the use of technology resources and package tools, curricular integration of laptops, classroom coaching and mentoring, and online training opportunities, including study groups and online courses. Because only one school selected Region 1 ESC's technology package and because the school is quite small, employing only five teachers in the fall of 2005, its data are omitted from discussions describing vendor-specific professional development in order to protect the anonymity of teachers and professional development providers.

First-Year Professional Development

The discussion of TIP's first-year professional development merges the voices of technology vendors, principals, teachers, campus-level technology coordinators and district-level representatives, such as superintendents and district-level technology coordinators, and includes information gathered from vendor and campus-level documentation of professional development activities. Small-group interviews with vendor representatives were conducted in the fall of 2005. Interviews with school personnel on all immersion campuses were held during campus site visits conducted throughout the spring of 2005. While each set of interview questions probed a range of TIP issues encompassing teacher training, the interview protocols for principals and teachers included questions directly addressing vendor-provided professional development. Principals were asked to describe the services provided by vendors and their level of satisfaction with professional development activities as well as the changes they observed in teachers over the first year of immersion. Teachers were asked to describe the format of professional development activities, the usefulness of training content, and their ability to transfer training content to classroom instruction, as well as to identify professional development needs that had not been met.

Not surprisingly, the bulk of the discussion of TIP professional development is derived from the descriptions of principals and teachers. And while teachers and principals frequently provide similar responses regarding the characteristics of professional development, there are some notable variances in their understandings of training and its effects on classroom practices. To some degree, these variances reflect the differences in the respective roles of principals and teachers and in each group's proximity to professional development activities.

Generally speaking, principals had an arms' length understanding of TIP professional development. All principals were familiar with the individuals providing the training and were aware of professional development schedules, but most principals did not fully participate in training activities. Several principals said they attended only a few professional development activities or got their information about training from teacher feedback forms. The comments of others (9) suggest that they attended early trainings covering basic skills but not later trainings when more in-depth information was presented. In contrast, core-content teachers attended most, if not all, trainings and report first-hand experiences with professional development format and content as well as the challenges of implementing training topics in classroom practice.

In addition, principals, acting as campus-level spokespersons for the TIP project, strove to present positive and, in some instances, inflated representations of TIP professional development and its effects. For example, principals reported "superb," "outstanding," and "absolutely fabulous" experiences with training, noting that "all teachers" were integrating laptops in their lessons and "all students" were actively engaged with technology. Teachers, however, were less burdened by the need to present positive descriptions of TIP implementation and offered more matter-of-fact representations of their professional development experiences.

Professional Development Provided by Dell/Co-nect and Apple

While Apple's and Dell's professional development programs were similar on paper, in implementation, clear differences emerged in how the two vendors structured teacher training. Table 5.3 presents descriptive information about training activities on Dell and Apple campuses over the course of the 2004-05 school year. The table's data are organized in terms of professional development "events," which are defined as periods of continuously provided professional development. For example, a professional development event may consist of a single trainer visiting a campus to provide training for a single day, or it may consist of multiple trainers visiting a campus to provide professional development spanning multiple continuous days (e.g., April 3 – April 5). As the table illustrates, Apple provided more training events per campus on average than Dell (9 versus 7.5). And, on average, Apple's trainings tended to last longer (2.1 days versus 1.3 days) and were facilitated by a greater number of trainers (1.8 versus 1.0).

Table 5.3. Professional Development Events by Vendor

	Dell (N = 15)	Apple (N = 6)
Total PD events 2004-05	112	54
Average events by campus	7.5	9.0
Average days per PD event	1.3	2.1
Average trainers per PD event	1.0	1.8

Note. N = Number of campuses. PD = Professional Development.

Further differences between the two packages become apparent as vendors described how they structured the provision of professional development and as school personnel described the services they received. The following sections provide an overview of Dell and Apple's professional development activities over the course of first-year immersion and describe some of the challenges vendors experienced in the course of providing training.

Overview of Dell's First-Year Professional Development

Contract with Co-nect. Dell representatives explained that they wanted professional development to be a process that built from introductory lessons in laptop basics to blended use of package tools and techniques for classroom integration. And Dell wanted package tools to be presented as integrated components of an instructional system and not as unitary, stand-alone products. To achieve this end, Dell contracted with Co-nect, a commercial professional development provider based in Cambridge, Massachusetts, to provide its technology immersion training. Dell organized its professional development such that Co-nect trainers conducted training in all package tools and third-party vendors (e.g., eChalk, netTrekker, iKnow) were not included in training activities. Dell reasoned that this arrangement would avoid the discontinuities that might arise if individual vendors presented, and perhaps promoted, their products in isolation, and it felt that Co-nect's consultants would provide unbiased feedback on the quality of its package tools.

Two Co-nect consultants provided professional development to Dell's 15 immersion campuses over the course of the 2004-05 school year. Both consultants were trained in the full suite of Dell's package offerings and had experience working as classroom teachers. The trainers were each assigned to a set of seven or eight schools and generally worked independently. Although training schedules varied, most Dell campuses (11) began meeting with their trainer in October 2004. Trainings usually lasted one to two days and were scheduled on a monthly calendar that ran through April or May 2005. Some trainings were scheduled as half-day events in which half of teachers met with the trainer in the

morning and the other half met in the afternoon, and some trainings were condensed to fit teachers' conference periods.

Early difficulties. According to Co-nect representatives, TIP's early months were fraught with challenges that wore heavily on its consultants. Training plans were frequently derailed because student data had not been loaded onto school computers in time for training, and password problems limited teachers' access to technology tools. The delays caused some initial frustration on three Dell campuses. "Things weren't working the way [Dell] thought they were going to work," noted one principal, "the input of the data that should have already been inputted that we already submitted and things like that. They weren't ready to roll." Co-nect representatives explained that these issues were artifacts of timeline problems that arose because third-party vendors were not willing to invest manpower in loading data or streamlining password processes until schools had a Notice of Grant Award (NOGA) in hand. The delays meant that consultants were often unable to provide scheduled professional development and were forced to improvise during early trainings.

Training in product tools and classroom integration. Co-nect launched its professional development program in a 45-minute session designed to create a shared vision for technology integration. "Vision" sessions generally were full faculty events that focused on TIP's objectives and spotlighted technology's role in achieving TIP's goals. After establishing a campus vision for technology integration, professional development addressed the basics of laptop use and care. Introductory instruction included such topics as turning on the laptop, identifying its components, and connecting to the Internet.

Once teachers were familiar with laptop basics, training focused on familiarizing teachers with package tools. The first tool to be introduced was eChalk, an online communication system designed for K-12 educational environments. Once teachers were familiar with eChalk, training moved to the package's academic search engine, netTrekker, and then to its assessment tool, iKnow. After initial product introductions, Co-nect trainers generally spent subsequent campus visits reviewing and extending teachers' knowledge of package products. Teachers said they appreciated that Co-nect's trainers presented material "step-by-step" and that repeated trainings "helped hammer in" the ways technology could be used in the classroom.

As a means to reduce lost class time and expenditures on substitute teachers, two-thirds of Dell campuses restricted some training in package tools to teachers' 45 to 50 minute planning periods. On such occasions, trainers set up in a teacher work room or conference space and met with teachers during their respective planning periods. The abbreviated trainings generally focused on introducing and reviewing the use of package tools, such as eChalk, netTrekker, and iKnow. Teachers' feelings about the shorter training format tended to be shaped by school size and the amount of individual attention they received. On some larger campuses, teachers said the conference period trainings were too short, leaving little time for teachers to explore package tools and ask questions. "I don't know what questions to ask" said one such teacher. "We don't have enough time," agreed another "We're there; [the trainer] says 'Okay, this is where you go. Click in. Look at it. Blah, blah, blah,' and the bell rings." However, teachers at some smaller schools appreciated the intimacy of planning period sessions. "These are very small settings," a teacher explained, "One, maybe two people at a conference period at a time, so it's very one-on-one. So you can [move] at your own speed…[the trainer] goes as fast as you want."

When teachers had established a level of competence working with package tools, the focus of training shifted to the identification of online resources and techniques for integrated instruction. Initial integration workshops focused on classroom configuration and discipline management in the one-to-one classroom as well as techniques for integrating laptops into lesson plans. These trainings

frequently included brainstorming and problem solving sessions in which teachers worked in groups to identify effective strategies for laptop integration and solutions to problems that may arise in integrated classrooms. The amount of time devoted to integration training varied widely across Dell campuses during the first year of implementation. Some campuses devoted multiple days to developing teachers' classroom integration skills, while others spent few, if any, days on the topic.

Classroom support. Principals and teachers at seven Dell campuses noted that trainers followed up training with classroom visits and described activities in which trainers "revolved to the classrooms" in order to speak with teachers individually. "[The Co-nect trainer] goes in the classrooms and just kind of visits," said one principal. A principal on another Dell campus described a similar activity:

> The first place [the trainer] went was the math class. [The trainer] talked to the teacher while she was teaching class, went right along with what she was doing and found something that would integrate into [what she was teaching], which really surprised her a lot and [she] ended up using it that day. Then he went around to the other classes and just said "I'm here because I wanted to do some support. Have you had trouble? Have you seen anything that works better than others? Well, let me tell you what I found out through working with the other 10 that I'm working with. They're having real good luck with this [website]. There's no use in trying this website in [ELA] because it's just not that good." The short cuts that he's allowed us to use have just been great.

Teachers on this same campus, however, did not recognize the trainer's visits as classroom mentoring or support. During the campus's teacher focus group interview, most teachers said that no classroom support had been provided over the course of the year and one reported:

> This week was the first time that I saw someone use the computer, you know, in the classroom and that helped me more than anything did. I would like to see more demonstrations on what to do, not just where to go.

Teachers on other Dell campuses described instances of classroom support that mirror those provided by principals. "[The trainer] wasn't that specific," said one teacher, "He was just kind of roaming, seeing what [students] were doing, just observed more than anything." A teacher on another campus said, "[The Co-nect trainer] has been to my classroom two or three times and has asked how it's going and has watched my classroom." Explaining further, the teacher expressed a desire to observe a model lesson, "I would love to see a modeled lesson plan. Like, have somebody come in and teach my class while I sit and observe them."

Additional support. Three Dell campuses contracted additional integration training from educational service centers (ESCs). ESC representatives trained teachers in the use of Microsoft's suite of programs and sometimes worked with students in classrooms. One Dell campus also received integration training from a local university.

Overview of Apple's First-Year Professional Development

Apple's coaching and orchestration managers. Apple provided its professional development through in-house consultants, titled "Coaching and Orchestration Managers," or COMs. COMs have worked as educators and "have years of experience in guiding educators and schools through a change process around the utilization of technology to improve the teaching and learning process" (2004, "Apple TIP Solution"). Apple assigned four COMs to act as lead trainers on the TIP project. Lead trainers were responsible for one to two campuses and were expected to attend all professional development events in order to ensure continuity across trainings and facilitate communication with school personnel. In addition to Apple's trainers, third-party vendor representatives attended many trainings, and Apple employed external consultants to conduct some subject-specific workshops.

Tailored training. Apple representatives assert that technology training must build a continuum running from the adoption of a one-to-one program to innovation with digital teaching tools and that the focus of its professional development is the "evolution of thought and practice" among teachers. They explained that there is no "one-size-fits-all" approach to professional development and that Apple's training is tailored to meet each campus's specific needs

Most of Apple's campuses (4) began meeting with trainers in August of 2004 and followed a largely monthly training schedule through May or June of 2005. Four Apple campuses began the 2004-05 school year with a TIP workshop spanning two to five days in August. These trainings were logistically difficult because teachers had not yet received their laptops and were required to share "loaner" laptops in order to participate in activities.

Apple's early trainings included introductions to laptop use and care, Apple's OSX operating system, and the iLife suite of programs, and allowed for third-party vendors to familiarize teachers with individual package products. Subsequent trainings focused on planning technology-infused lessons and techniques for classroom integration. Trainings were generally half- or full-day sessions that spanned the course of several days, and many trainings involved teams of trainers. During team trainings, Apple's COMs facilitated training in Apple tools, such as iMovie and iPhoto, and provided classroom coaching and support for teachers; third-party vendors provided training in package products, such as My Access Writing and KidBiz; and specialists trained teachers in the use of subject-specific integration techniques and tools, such as digital microscopes for use in science. Principals said they appreciated Apple's team-based approach to professional development:

> If there was something that the [Apple trainer] was not well versed in, then they would get with the [third-party] vendor partner and bring out somebody that was an expert in one of the other software packages, and they would pair with them. They would come out and work together. So [Apple] did a lot of legwork for us as far as managing the big picture of professional development.

Teachers on Apple campuses described trainings that were generally full staff unless content was subject-area specific. During full staff activities, teachers frequently broke into groups organized by grade level or subject area. For one subject-specific training, the science and math teachers at two campuses met with one of Apple's external consultants for a joint training in the use of temperature probes and graphing programs.

Teachers appreciated that Apple trainers introduced programs one at a time, moved slowly through training content, provided classroom support, and set reasonable expectations for teachers' progress. Teachers explained:

> [The Apple trainer] was very good about saying, "You don't have to go from zero to 90. Gradually, implement what you can implement, and don't feel like you have to be doing Keynote presentations the second week that you've got the laptops."

Although Apple's trainers did not rush teachers' use of technology resources, they did require teachers to complete assignments using package products and followed up with visits to individual teachers' classrooms. Teachers on one campus said:

> [The Apple trainer] gives us assignments, ways to actually use it in the classroom, and then he works with us doing it so that we actually learn it and are able to go back and do it in the classroom.

And on another campus:

> [The Apple trainer] was pushing us …we built on something, started with the small concept and built on it and extended further, and further, which is the way he wanted us to work.

Classroom support. Principals across Apple campuses noted that trainers' follow-up sessions working in individual classrooms were integral to teachers' ability to transfer training content to classroom practice. Principals said that Apple trainers assisted teachers in planning technology-based lessons, provided feedback on observed lessons, and spent time co-teaching and modeling lessons. One Apple principal observed:

> The professional development folks come in and work with our teachers for entire days and do co-teaching and reflection on lessons and lesson planning and that, I think, has been the key to how much success we're seeing, is providing that hand-in-hand support on a long-term basis rather than a drive-by professional development session. And that's really exciting.

The district technology director for one Apple campus explained:

> The [Apple] team that has been coming, they have worked with content-area teachers and [have] been able to go in there and model teach with them and co-teach with them and help them plan lessons.

The campus's teachers reflected the same view:

> [The Apple trainers] stay with us for about two days and they'll [observe you teaching] if you want, they'll co-teach with you. They'll just help you during the planning period.

Teachers on another campus offered a similar description of Apple's approach to observation and coaching, "[the trainer] comes to our classrooms and observed [lessons] that we've done just to offer suggestions and advice on what we could do differently, what we could do better."

The following sections provide greater detail about the first-year professional development activities that occurred across both sets of campuses, describing the notable features of TIP professional development, its effects and challenges, as well as teachers' unmet training needs.

Notable Features of Professional Development

Differences from other trainings. Pointing to the benefits of interactive and recurring instruction for teachers, one campus principal highlighted the differences between TIP training and more traditional forms of professional development:

> …normally in this business, we have a one-day workshop. We tell [teachers] what to do, and then we leave them alone. I think this has been a benefit to my teachers to have [trainer] continually come back and kind of sit with them and say, "Hey, what kind of problems are you having and what's going on?" It's just been a great benefit to do that.

Teachers said that TIP professional development was more relevant to their daily work in classrooms. One teacher said, "It's different [in] that you could go back to the classroom and use it." Teachers on another campus said:

> [Other trainings] just give you strategies and stuff, and they do it just to comply with the requirement for the six-hour update. It's "Get it over with," whereas with the TIP, it's been, "Now, if you're going to use this, make sure to do this, and this." They give you details about problems you might run into.

Teachers at more than a quarter of schools said that TIP professional development was more interactive and "hands-on" than other trainings they had attended. At two schools, teachers noted that TIP professional development was not as focused on TAKS objectives as other trainings, and teachers and principals at several campuses appreciated that TIP professional development occurred on campus rather than at a service center or another location. "I think that we're getting more out of [professional development] where [trainers] come to the school," said one such principal.

Vendor relationships. Respondents discussed their relationships with primary professional providers who facilitated most TIP trainings as well as their associations with third-party vendors who provided ancillary trainings in individual package products.

Relationship with primary training providers. The importance of a strong connection with trainers was a consistent theme running through both teacher's and principal's comments about professional development. Principals valued that professional development providers were "likeable" and able to build strong individual relationships with teachers. "Teachers are just like kids," said one principal, "If you don't make the connection, you're never going to have their attention...That connection is more important, when you come to [provide training], than anything else." A principal on another campus described teachers' relationship with their trainer:

> The teachers are very open with him, very comfortable with him. He's been just a tremendous benefit throughout this whole process. He's got good experience that he can relate to us that he's seen with other schools, and he's seen us from day one.

"He's one of us!" declared the campus's teachers of their trainer. And teachers on all campuses expressed appreciation for and a sense of camaraderie with the trainers who worked with them.

Relationship with third-party vendors. Because Dell excluded third-party vendors from training activities, Co-nect's trainers provided training in all package products. This structure meant that Co-nect consultants sometimes spent professional development time addressing vendor-related software, data loading, and password problems, and that teachers on Dell campuses relied on Co-nect trainers to mediate software problems with vendors. "When I did have some problems with netTrekker, I emailed [the Co-nect trainer] and said I keep having this problem," a teacher on one Dell campus explained, "And [the Co-nect trainer] emailed back and said he's taking care of it. And he did."

In contrast, teachers on Apple campuses established relationships with individual vendor representatives, which enabled them to address issues with package tools more directly. Teachers on one Apple campus described their contact with third-party vendors, "[Vendor representatives] have all given us their card and their number so we can call or email," said one teacher. "I have had some problems with KidBiz and I have a lady that I call, I have her product line number, and if she does not hear from me for a few days, she calls me," said another. Still another explained, "I interact with KidBiz through the teacher program. They send emails on updates and [have] a place where I can ask them [questions] and I get a response back within 15 minutes."

Effects of First-Year Professional Development

Increased comfort with technology. Teachers and principals reported that comfort with professional development providers translated into increased comfort experimenting with technology in the classroom. "You cannot overlook the staff development," said one principal, "…it's easy for teachers to build lessons, but to go in and implement those lessons using this one-to-one type atmosphere is definitely different." "[The training] has really boosted my confidence," explained a teacher on the same campus, "If [the trainer] comes in and tells us that we can do this, and then they, literally, show us step-by-step how to, then I'm more encouraged to try it on my own." A principal on another campus shared a similar observation:

> I attribute most of our success—we haven't been able to measure it, but just from the feeling—it's been because of [the trainer]. He made our teachers feel that they can do it, and they have been able to do it.

According to many principals and teachers, increased comfort using technology in the classroom was the most palpable effect of first-year professional development.

Transfer to classroom practice. In general, principals tended to describe more substantive changes in teachers' classroom practice than those reported by teachers. "I think that teachers have changed their whole way of thinking in teaching," said one principal, "They involve. Instead of just teaching different chapters they go online…and search one of the websites…and find [ ] in-depth knowledge." However, teachers on the same campus were more understated in their descriptions of changes. "We've tried to implement [what the trainer taught us]" said one such teacher, and "…I just try to go with what I've been taught" added another.

Principals at other immersion campuses said that teachers were less reliant on textbooks and "TAKS formatted" lessons, posted assignments on Web pages, and were more likely to act as facilitators of student-centered instruction:

> You see [teachers] monitoring more, walking around more. A lot of our teachers have done away with desks and put tables in because it's easier to monitor the set up of the computers versus when they're all in rows like this. I've seen the classroom design change a bit.

Teachers, for the most part, described the effects of training in terms of classroom use of package resources and equipment. "I use Classroom Connect" said a teacher in one focus group. "I wouldn't have known how to use netTrekker," said a teacher on another campus, "I would have used Google or Yahoo! or something." Once teachers were familiar with resources, they valued professional development that extended their ability to use resources. One focus group described their most useful training as "[t]he one where [the trainer] showed us how to get a website and link to it on our eChalk. That was the one we used the most." For other teachers, simply learning to use an LCD projector had a strong influence on classroom integration:

> When [the trainer] showed us how to use the LCD projector, that opened new doors because there are so many things that the kids can interact with online that they don't really understand how to do. You show them on the LCD projector, and they've got it. You don't have to go to each individual desk and show them or have them gather around your desk and show them. So that was a tremendous help.

While teachers at more than half of immersion campuses commented on the usefulness of training and said that they were able to transfer what they learned to their classrooms, teachers on four campuses said that TIP professional development had no effect on their classroom practices. On one such campus teachers said, "It's like everything's still the same; the only thing is we have new equipment." On another, teachers said they had changed but "not because of the professional development." The teachers said they were self-taught and learned integration by implementing their own ideas, "Basically, the professional development was, 'This is available to you. Check it out.' So, we kind of learn on our own."

Resistance. In spite of training, some teachers openly expressed indifference about the need to apply new skills. Teachers in one focus group said, "It's basically, they come and present, and it's up to us how we're going to use [the training] in our classrooms."

Most principals (13) reported experiencing some initial teacher resistance at the outset of TIP but said that teachers' attitudes improved as they became more familiar with the project. Six principals, however, said that gaining teacher buy-in remained a central challenge of implementing technology immersion and three others reported that persistent and strong teacher resistance hampered immersion efforts. Student excitement about the laptops countered some teacher resistance. "You can't let [the laptop] sit there on the shelf," said a teacher in one focus group, "I mean… the kids want you to use it somehow." "You can't overlook the students' enthusiasm," acknowledged teachers on another campus. Principals also commented that student pressure to use the laptops in class caused resistant teachers to experiment with laptops in the classroom. One principal explained:

> After a while [resistant teachers] had to buy in because the kids were so excited. The kids wanted to use the laptops, and the good thing is, I think, a lot of the kids have taught some of these reluctant teachers a lot of the usage.

As a means to further discourage resistance, principals on at least two campuses set requirements for classroom technology use and monitored teachers' lesson plans. And on another campus, teachers explained that administrators established clear expectations that professional development topics would be integrated into classroom practice.

Retention of training content. In addition to teacher resistance, retention of training content posed an obstacle to teachers' ability to apply what they learned to classroom instruction. Many teachers noted the difficulty of retaining professional development when too much time elapsed between the training and the opportunity for classroom implementation. Teachers in one focus group explained:

> We're being trained on something, but we don't have the kids in there…It was a couple of weeks before we could get the kids [using the program]. Well, by that time I had kind of forgotten how to use it and lost interest in implementing it.

On another campus, teachers said:

> It was fun while you were [in training], but the minute you left, it was like we didn't use it again because we took it early—[in] the summer—so you forget about how to do it.

In most instances, the lapse between teacher training and implementation was a function of professional development calendars that scheduled teacher training in package tools weeks or months before students received laptops or had programs fully loaded. However, some teachers said they forgot training content because advanced topics were scheduled too early in the training cycle. These teachers said they did not retain the content of advanced training because they had not yet mastered program basics.

Teachers on some Apple campuses felt that the intensity of full- and multiple-day trainings were barriers to retention because teachers did not have the opportunity to apply new skills before learning even more new material. A teacher on one Apple campus explained:

> [Training activities] all kind of run together for me after a while. There was so much, and it's an all day thing…and before I have a chance to actually implement it in my classroom, I'm back out of the classroom doing something else. I did not like that at all. I like more time between the trainings to try to actually implement the first [training's content] before I've gone to the second one.

Teachers on another Apple campus expressed a similar view: "If I don't have time to use it whenever it's demonstrated to me, then I lose it. It's like anything...I think we were given so much so fast, we didn't have time to absorb anything."

Teachers at three campuses suggested that retention could be improved if professional development included written materials covering training content. One teacher explained, "…there is no book with instructions given to us at training, so therefore you get back to your room and you're going, 'Okay, what did she say? Where did she go?'" Another teacher agreed, "A technical writer needs to write this stuff up so that we have what they're giving us in our hands at any time. When I'm at home at midnight writing lesson plans, I'll have it."

Scheduling Challenges

Summer professional development schedules. The scheduling of professional development during the regular school day created problems for school administrators and teachers alike. Administrators described the need to balance teachers' need for training with the amount of time substitutes spent in classrooms. One principal described the problem:

> We have really run up against a roadblock in terms of balancing the need for more professional development and the loss of teacher time. When a substitute's in the classroom you are maintaining at best, and many times going backwards. If you can avoid doing that training during class time, then obviously, that would be an advantage.

Teachers also worried over the amount of class time lost to professional development. Teachers in one focus group said they "resent[ed]" the amount of time spent in professional development, and teachers on another campus said:

> It has taken us out of class a lot. And some of that's good, and some of it's bad. I mean, it's been wonderful learning the things but…we have been out of class a great deal.

In response to concerns over lost class time, more than a third of principals said that they planned for more professional development to take place during summer months, and district-level administrators expressed support for summer training plans. However, principals were aware of the difficulties inherent in scheduling professional development during the summer. One principal explained:

> And say that I have to [schedule training] in the summer time. [Teachers] are not going to be here. I have to bring them from their rest to come and learn, and so bringing them back will be a challenge.

Underscoring the challenge, teachers at several campuses said they would not attend summer training because it would intrude on summer plans. "We're not going. None of us are going to be able to go," said one focus group in response to training scheduled during summer months.

TAKS schedules. In addition to scheduling professional development during the regular school day, a number of principals expressed concern about protecting teachers' class time in the weeks preceding TAKS testing. "I've asked [trainers] not to come in April because that's our four or five weeks before TAKS," said one principal. And some teachers said that pressure over TAKS testing inhibited their efforts at integration:

> You know, I could do an iMovie or some sort of multimedia project—even PowerPoint or Keynote—with the kids each time we do a unit, but I can't because I have to cover all my material by February. So I don't have time to do any extra…I'm short on time because [my TAKS test] is in February, so I can't do a lot.

A principal on another campus expressed a similar view:

> How [can teachers] balance the TAKS with computer use because the TAKS has nothing to do with the computer. And nobody's going to say, "Oh, well, you know, we understand your TAKS scores. I know you all had computers and you had to use it for this particular project." Nobody's going to understand that.

Professional Development Needs

Content-specific professional development with peer-sharing opportunities. Some teachers expressed frustration at having to attend trainings that did not apply to their subject areas. Teachers explained, "…all of us would have to show up. It's like 'Why am I here? This has to do with writing—I have nothing to do with writing.'" And on another campus:

> [Trainers] try to make everything fit everybody's needs, which, when you have a PE coach and the librarian [and] someone that teaches language arts—our curriculum is so very different—it either applied to some of us or it completely did not. So I think it bored a lot of people.

Teachers on several campuses said that they would like to have an opportunity to share with and learn from teachers who teach the same subject on other immersion campuses. One teacher explained, "If we could talk to teachers from our own subject areas, it would be a lot better for us." A teacher on another campus said:

> ...if I can go to an English teacher's classroom and sit and watch them and how they're integrating technology and watch a whole lesson, and then be able to sit down and maybe visit with that teacher for 30 minutes and just talk about "Why did you do this and how did you do this and where did you get this?"

The teachers said that subject-area interaction is the most beneficial aspect of professional development generally, and "With this technology, it's the same thing. I hate having to learn everything by trial and error when I could be using somebody else's expertise."

Pacing of training and ability levels. Teachers in many focus groups said they needed more training in laptop and program fundamentals at the project's outset. Teachers said that trainers assumed they had greater experience working with laptops than they had and that some early trainings were taught at too high a level—"[The trainer] started with Connect and iKnow, and we still needed to just learn the basics, like how to turn it on."

Vendor representatives also expressed frustration that early professional development activities were not well aligned with teachers' ability levels. Citing project restrictions on the use of a formal needs assessment for teachers' technology use,[2] vendors explained that plans for early trainings were made with little if any information about teachers' technology proficiencies. When trainers met with teachers during initial training sessions, they realized that some campuses would require extensive training in basic skills and reworked training schedules to include topics such as the components of the laptop, connecting to the Internet, and saving files.

Beyond the experience with early trainings that were not aligned with teachers' ability levels, some teachers felt that the overall pace of TIP professional development was too fast. A teacher in one focus group said, "I felt left out of most [trainings] because I know nothing, and it was geared to people that were knowledgeable about the computer… [Trainers] are not working with us according to our ability." A teacher on another campus did not retain much of the content when training was not at her level, "I was getting like 25 percent of it...That didn't do me any good at all." In response to frustrations with the pace of professional development, teachers on five campuses suggested that training activities should be organized in terms of teachers' ability levels.

Classroom modeling and support. Teachers and principals at many Dell campuses (7) expressed a need for classroom modeling and support. Teachers said that professional development activities emphasized use of package tools and the identification of online instructional resources, such as lesson plans and class projects, with little attention to demonstrating integration techniques or modeling lessons. "You can't just send us to a website and say 'Read about this,'" one teacher explained, "We need people to come in here to talk to us, show us." Teachers on another Dell campus expressed a similar view:

[2] In order to reduce survey fatigue for teachers who were required to complete TIP evaluation surveys at the project's outset, professional development providers were restricted from conducting surveys of teachers' training needs.

> There is nobody on campus to [model lessons], and I think that is hurting us because we can go to all the trainings that we are offered and be at every single little thing, but if we do not have the support, we can't move forward like we want.

Regretting the absence of in-class training and support, a principal on another Dell campus said, "The part that I needed from [Co-nect] was to show the teachers how to implement what you taught them, show them how to implement it in the classroom, where it's going to be the most effective."

In sum, despite efforts through the RFQ process to standardize professional development, clear differences emerged during the first year between the Dell/Co-nect and Apple models. Apple provided more training events, and events lasted longer and involved more trainers. Apple's third-party product vendors also provided professional development and support, whereas Dell/Co-nect presented tools as an integrated part of their instructional system and excluded third-party vendors as trainers. Still, in spite of format differences, Apple and Dell/Co-nect trainers encountered similar challenges, and for the most part, appeared to achieve similar outcomes. Teachers at all campuses grew in their technology proficiency and comfort with technology but struggled to incorporate the content and instructional strategies introduced during professional development into their day-to-day classroom practices.

Resource Utilization

Teachers and students at immersion campuses each received a wireless laptop loaded with digital learning resources. Immersion packages, provided by Apple, Dell, or Region 1 ESC, included productivity and communication software for use as learning tools, online instructional resources that supported the state curriculum in English language arts, mathematics, science, and social studies, and online assessment tools designed to diagnose students' strengths and weaknesses and/or to assess their progress in mastering the core curriculum.

In focus group discussions, teachers identified the package resources they found the most useful, those they found least useful, and described the frequency with which they used resources. Brief descriptions of the available resources, followed by teacher comments are detailed below.

Wireless Laptops and Productivity Software

All vendors offered a wireless laptop as the mobile computing device. Campuses could select either Apple laptops (iBook and MAC OSX) or Dell laptops (Inspiron or Latitude with Windows OS). For Apple laptops, AppleWorks provided a comprehensive suite of productivity tools, including Keynote presentation software, Internet Explorer, Apple Mail, iCal calendars, iChat instant messaging, and iLife Digital Media Suite (iMovie, iPhoto, iTunes, GarageBand, and iDVD). For Dell laptops, Microsoft Office included Word, Excel, Outlook, PowerPoint, and Access. Region 1 ESC offered Dell products.

Productivity resources such as PowerPoint, Excel, and word processing programs, were popular with teachers because many had prior experience using these resources and because the programs were not Internet dependent. Noting that Internet connections often failed, one teacher expressed her appreciation for word processing programs, "You don't have to rely on the Internet; you don't have to rely on things that can go wrong within the classroom."

Online Instructional and Assessment Resources

In addition to the productivity tools included as part of Appleworks and Microsoft Office, immersion packages also include a variety of online resources (see Table 5.4). Apple included the following online resources: netTrekker (an academic Internet search engine), Beyond Books from Apex

Learning (reading, science, and social studies online), Math ClassTools from Apex Learning (complete math instruction), ExploreLearning Math and Science (math and science concept simulations), KidBiz3000 from Achieve 3000 (differentiated reading instruction), and My Access Writing from Vantage Learning (support for writing proficiency).

Table 5.4. Instructional and Assessment Resources

Apple	Dell	Region 1 ESC
netTrekker (Thinkronize)	eChalk	eChalk
Beyond Books (Apex Learning)	Connected Tech (Classroom Connect)	Connected Tech (Classroom Connect)
Math ClassTools (Apex Learning)	netTrekker (Thinkronize)	*i-know* (CTB McGraw-Hill)
ExploreLearning Math/Science	*i-know* (CTB McGraw-Hill)	Unitedstreaming (digital videos)
KidBiz3000 (Achieve 3000)		Encyclopedia Britannica
My Access Writing (Vantage Learning)		EBSCO (databases)
StandardsMaster (Renaissance Learning)		NewsBank (TEK resources)
		K12 Teaching & Learning Center

Dell selected netTrekker (an academic Internet search engine) and Connected Tech from Classroom Connect (technology-based lessons and projects). Region 1 ESC selected Connected Tech and added a variety of teaching and learning resources, including Unitedstreaming (digital videos), Encyclopedia Britannica, *EBSCO* (databases), NewsBank, and K12 Teaching and Learning Center. Both Dell and Region 1 ESC offered eChalk a "portal" to other web-based applications and resources.

For the Apple package, *StandardsMaster* (Renaissance Learning) provided a formative assessment in all four core subject areas. Both the Dell and Region 1 ESC packages included *i-know* (CTB McGraw Hill) for core-subject area assessment. In addition, all campuses had access to the online Texas Mathematics Diagnostic System (TMDS) provided free of charge by the state.

Instructional resources. Many teachers reported limited use of TIP instructional resources during first-year implementation. Some teachers said they lacked the skills and training to use the resources. "We can't judge them because we don't know how to use them a lot of times…and we don't know what else is available," said teachers in one focus group. A teacher on another campus explained:

> I think the resources are there; we just need more time to utilize them…We have to make them ours first before we can make them theirs [students']. If we don't know about it to manipulate the software, then we're going to have a hard time making it possible for them to manipulate the software.

While inadequate training limited some teachers' use of resources, others said they became frustrated when resources did not work as expected. One teacher explained:

> Our eChalk does not work, so I was spending hours and hours and hours putting all these lessons plans and websites for the kids and the kids can't access it, so after about three weeks I just gave up. So I still do Internet and technology immersion but I have to go straight to the website, I have to tell the kids the website. I can't use the eChalk email for them or any of the lessons. That has been really frustrating.

Teachers' problems with online instructional resources, however, often were caused by campuses' inadequate Internet connections rather than flaws in the products themselves. Teachers at four campuses voiced another concern. These teachers said they did not use resources because they did not feel the programs improved student learning.

Online assessments. Very few teachers reported using online assessments. Some teachers said they were waiting for technical issues to be resolved or required training before they could incorporate assessments into classroom activities. However, other teachers said that assessment tools were not well matched to their curricula. "I do remember looking at a website that had a bank of assessment questions," explained one teacher, "but very, very few that were sixth grade English and language arts." The teachers who did use assessment tools appreciated that they provided students with immediate feedback:

> … instead of waiting for me to call them, …[students] they were able to go in and read whatever information as far as what they needed to improve, which they were supposed to go in and try to correct…Then when I got to them, I could see, "Okay, this is what you did and this is how you improved," or "Okay, I don't see any improvement."

Resource needs. Teachers and principals at five campuses pointed to the need for more package resources designed to support mathematics instruction. Some teachers also expressed a desire for more package resources aligned with TEKS and TAKS.

With the exception of productivity tools included as part of Microsoft Office and the AppleWorks suites of programs, package resources generally had limited use over the course of first-year implementation. Teachers' said their reluctance to use package resources was rooted in a lack of training, school infrastructure problems that limited Internet access, and frustration with products that were not properly installed. In addition, some teachers resisted implementing package tools because they did not recognize the benefit for students or because they did not think the resources were well aligned with subject-area curricula and TAKS. A subsequent section on classroom immersion includes additional examples of teachers' and students' reported uses of various TIP productivity tools and resources as well as their uses of digital resources that were not part of the immersion packages.

Implementation Supports for Technology Immersion

Information collected during the first year revealed that campus and district leaders played a critical role in the implementation of a technology immersion project. Consistent with results from other research studies (Hallinger & Heck, 1996 cited in Spillane, 2003; Rosenoltz, 1989), we found that administrative leadership is necessary for creating and maintaining the conditions that support school change and improvement, and evidence indicates that principals, in particular, play a central role in technology immersion. In addition to leadership support from campus and district leaders, community and parent buy-in is an important part of successful technology immersion.

Leadership

The following sections describe district and campus leadership at immersion campuses during the rollout and early implementation phases of TIP. Information is drawn from interviews with district and campus leaders and from focus-group discussions with teachers.

District Leadership

Researchers requested an interview with at least one district representative who had first-hand knowledge of the TIP project. Interviewed representatives included superintendents (9), assistant superintendents (2), district technology coordinators (5), and other district personnel (4). In two districts, no district representatives were interviewed, whereas in two large districts, we interviewed two district officials. Representatives described their roles in the project and their levels of interaction with immersion campuses.

About a third of district officials had been involved in the TIP project since the grant application process, and nearly all were involved to some extent in first-year implementation. A few administrators, however, were new to their districts and not completely familiar with TIP. Administrators' roles in TIP varied. In some districts, administrators acted as project directors overseeing project implementation as well as purchasing and budgetary tasks. Other administrators who acted as district technology coordinators said that the provision of technical support was an important part of their TIP responsibilities.

Levels of administrator involvement with immersion campuses also varied. Two district representatives said they had few TIP-based interactions with schools, while others described substantial project involvement. One superintendent explained: "I've been over involved in the teacher training. I've been to all the meetings with the TIP grant…From the ground floor up, I've been involved with it at the campus level daily. I speak daily with our TIP coach and coordinator at the campus." A district technology coordinator in another district described her role:

> I interact in every aspect of [TIP]—from working with the administrator in terms of setting policy to working with the teachers to help train them in the use of the programs and the use of the hardware down to whenever we do service or we have problems with the kids. I'm part of that group that actually interacts with the kids and helping out the IT, the people who really work with fixing the laptops.

About a fourth of district representatives reported that they interacted with schools on a weekly basis. A district technology director in one such district explained, "We have a weekly conference call every Friday at 8:30, and basically we have an agenda that drives that conference call, and we have minutes for that." In other districts, however, administrators had more informal and less scheduled interactions with immersion campuses. One superintendent said he visited his immersion campus, "If I know I'm going to have 30 minutes free." "I've been to planning sessions," said a district technology coordinator in another district, "and whenever they have a question, or if we need to communicate, then we talk." About half of the district representatives reported making visits to schools. Some also attended meetings with campus administrators and teachers or conducted conference calls. Several district representatives reported attending rollout events.

In spite of administrator efforts to remain involved with immersion campuses, teachers on some campuses did not feel they provided enough support for immersion. "I wish…that our TIP coordinator was on campus, because she's not," said one focus group teacher, "She doesn't spend a lot of time here. We don't have a really good instructional leader on our campus that really helps with [integration]." Teachers in another district recognized but had little interaction with the district-level support staff for their campus. "I don't know her name. I know who you're talking about," said one focus group teacher of the district representative.

Overall, district representatives described wide variations in their level of involvement with immersion campuses. Some district representatives had little interaction with the schools while others took on key roles and were involved in the grant writing and daily oversight of the project. Still, across all levels of involvement, nearly all district personnel characterized their district's attitude toward the project as overwhelmingly positive—committed, enthusiastic, and excited. For example, one district technology coordinator said, "I think our district has really bought into it. I think that everybody supports it from the top down. I see very little resistance and very little negativity at all." A superintendent in yet another small rural district stated, "We're thrilled to death to have the opportunity to participate."

Campus Leadership

During interviews, principals at all immersion campuses responded to a series of general questions addressing TIP implementation, and while none of the questions directly addressed leadership for TIP, some principals' responses illustrated their support for faculty and students as their campuses progressed toward immersion. For example, one principal scheduled a weekly 45 minute TIP planning period in which teachers worked with grade-level and subject-area colleagues to plan technology integration. Two principals supported immersion by creating requirements for weekly classroom laptop use and monitoring teachers' lesson plans. Another principal led by example by using PowerPoint presentations for faculty meetings, as well as email communication and online submission of lesson plans. Recognizing that many students did not have home Internet access, six principals extended students' access to school facilities and wireless networks during non-school hours. One principal set up a weekly schedule of access times, and five others opened their campuses, permitting students in the building before the first morning bell or after classes let out in the afternoon.

Teachers were most aware of principals' leadership and support for immersion when administrative actions bettered their classroom experiences with laptops. For example, teachers in several focus groups said they appreciated that administrators created and enforced policies related to students' inappropriate use of laptops. One teacher explained:

> [The laptop policy] really helped, because now I have the support when I say, "I don't want you on it [playing games]," I can say…"and neither do they [campus administration]." So you have a lot of support there.

Teachers on another campus appreciated that while their principal had clear expectations that they integrate laptops in their instruction, he was not critical of their efforts. One teacher noted, "[Principal's name] has been really supportive about not everybody's going to be using them to the same degree." Another teacher agreed:

> I don't feel like if the principal comes in [the classroom, he'll say,] "Well, you shouldn't have done that. You should have known better." I've never got that feeling, and that's really important from a teacher's standpoint.

Underscoring the importance of the principal's role in the project, teachers at two campuses with vacancies in the principal's office commented that the absence of campus leadership was hindering their efforts at immersion.

In sum, principals provided support for immersion in several ways. Some facilitated teachers' integration by scheduling planning sessions devoted to immersion, others required teachers to use laptops in class, and still others modeled integration techniques in their communications with staff. Principals supported students' use of laptops by expanding access to school facilities and wireless networks, and they supported teachers by establishing policies that bolstered classroom instruction with laptops and by encouraging teachers' initial attempts at integration.

Like district-level administrators, principals tended to present an exceedingly positive, and perhaps inflated, depiction of first-year implementation. For example, some principals said that TIP "energized" teachers—"all" of whom were integrating laptops in instruction—and produced "tremendous benefits" for schools. While administrators may be sincere in their comments, the exaggerated tone of some responses suggests that principals and district personnel believe leadership for TIP involves presenting the best face for districts and campuses as they struggled with first-year implementation.

All in all, campus and district leaders confronted many challenges during TIP rollout and early implementation. Interviews with district administrators and principals at immersion sites revealed uniformly high levels support for technology integration; however, this enthusiasm did not always translate into the concrete leadership needed to ensure that the school made steady progress towards immersion. Principals were confident that technology integration was occurring but only a few said that they held teachers accountable for technology integration by, for example, creating requirements for weekly classroom laptop use and/or monitoring lesson plans. In addition, the varying timeframes for laptop rollout described earlier suggested that campuses had inadequate time for planning.

Parent and Community Support

Teachers, principals and district administrators at the immersion campuses discussed ways that they tried to build parent and community support for the project during the rollout and early implementation stages. These efforts, however, met with varying degrees of success.

Parent Support

Because the TIP grants were given only to schools defined as high-need, a large percentage of families with children in immersion schools did not have a computer or Internet connection at home. And lack of experience with computers, generated a variety of parental responses to the laptop project. Most parents welcomed TIP and the opportunities it offered, but others were concerned that the project imposed additional responsibilities on parents.

As discussed previously, some parents were unable or unwilling to share the costs of insuring computers. In addition, some parents lacked confidence in their children's ability to care for laptops, and others worried about the need to supervise students' home use of laptops. A teacher explained, "Some parents complain because the kid does not want to do anything because they just want to play games, so they [parents] get upset." In response to parents' concerns over supervision, several campuses offered classes designed to teach parents techniques for monitoring students' laptop use. "I can protect what's at school, but I can't protect what's at home," explained a principal on one such campus, "[Parents have] got to know what they're doing."

Beyond parental concerns over students' use of laptops, principals and teachers on more than a quarter of immersion campuses reported that TIP had improved parents' computer skills as well as those of students. Teachers in one focus group said that students taught their parents new skills, and in another a teacher said:

> It's exciting to me if I'm at the grocery store and a parent says, "I can't wait until my kid goes to bed so that I can get on the laptop." And I just think that's fun because we're small and we don't all have opportunities to have technology at home, and I just think it's been wonderful to broaden the skills of the parents as well as the kids.

Four immersion campuses offered evening classes in basic computer skills for parents in conjunction with TIP.

Community Support

Although few interview and focus-group respondents discussed the broader community response to TIP, two district representatives believed the project had been a "point of pride for [the] community" and stimulated the economies of their rural towns. One superintendent explained:

> So the community feels like this is a way to stimulate economic development in our community. It's a way to get people to come to [city name]. Our kids have this resource where

> a lot of other school districts don't. I talked to a family during the summer, and they were thinking about taking their kids out…I said no. Your student at [middle school] is going to get a laptop computer.

Not all communities, however, were as receptive to TIP, and principals in four other districts expressed a need to win more community support for technology immersion.

Overall, the level of parent support for immersion varied across campuses. At some sites, parents viewed the laptops as an opportunity for their children to gain new skills and knowledge, while other parents feared the financial repercussions of the laptops and worried about their ability to monitor students' access to inappropriate material. Some campuses were more proactive in addressing parents' concerns and offered instruction in monitoring laptop use and provided classes in computer skills for parents. Little is known about the role of local communities during first-year implementation. While a few schools reported community support for the project, several principals noted that gaining community involvement was central administrative challenge.

Progress toward Classroom Immersion

This section first portrays technology use trends at immersion campuses during the first year, including descriptions of the types of technology-based projects and assignments teachers gave students. The next part describes the frequency of technology use in classrooms and provides an overview of technology use in core subjects: English language arts and reading, mathematics, science and social studies. Finally, teachers' perceived barriers to successful classroom technology immersion are described.

Information comes from teacher and student focus groups conducted during spring site visits, as well as interviews with principals and campus technology coordinators. Teachers described how they used technology in their classes and were probed for examples of their students' technology-infused projects and assignments. Randomly selected sixth graders described how and how often they used laptops at school, with specific probes to garner examples of projects and details about their use of laptops in core-subject classes. Findings to follow are generally ordered by the frequency with which students and teachers at each of the middle schools mentioned various technology uses. Although students and teachers at other schools may have engaged in similar activities and just did not report them, the regularity with which individuals cited particular topics provides a general profile of laptop use for teaching and learning.

Technology Use Trends

Teacher and student comments on the use of laptops mainly related to their use for lessons and assignments, management of academic tasks, and communication. Overall, teachers most frequently had students conduct research on the Internet, engage in activities designed to increase their basic factual knowledge, use word processors for writing or typing, or create various kinds of presentations. Teachers and students less commonly reported activities such as submitting and accessing assignments electronically or communicating via electronic media.

Complete Lessons and Assignments

Research assigned topics on the Internet. In nearly all schools (21 of 22), sixth graders reported that they frequently searched the Internet for information on a particular topic as a part of class work. For example, in one middle school a sixth grader said, "We had to pick a country and what kind of food they do and we had to get all the information from the Internet." In another school, students did a

research project on their community, and they used the Internet to find information on their small town. Overall, sixth graders talked confidently about seeking information on the Internet via search engines such as Google or Yahoo!, and occasionally, netTrekker. In some cases, students described multi-step, complex research projects, whereas in other instances, the task was simply to gather descriptive information. Internet research on a topic was frequently accompanied by the use of a word processor or presentation software to create a written or visual product.

Develop presentations or informational slides. Students at about three-fourths of schools (17) reported using presentation software such as PowerPoint or Keynote to create presentations or slideshows for assignments. Presentation software often was used as a tool for compiling information on key vocabulary words or basic factual information rather than for more complex projects that culminated in a student-led presentation. For example, students in one school searched online for vocabulary definitions and pictures of the skeletal and digestive system and created a presentation with Keynote. In contrast, other students described how they researched a topic, prepared a report, and developed a presentation. One sixth grader explained, "We've been doing PowerPoints on propaganda. We've done a report; it took a lot of our time, and we used our laptops for the Internet searches."

Take or prepare for tests. Students in nearly two-thirds of schools (15) said they used their laptops on at least one occasion to either take a test or practice for a test. However, assessments were typically not the ones included in the immersion packages. Teachers most commonly had students use assessments readily available at websites as a means to review for the state assessment (TAKS). Students in two schools talked about a web-based program called Study Island, which provided assessments and reviews in various subject areas. Other students simply reported that they had "tests on the computer" or "went to a website to take tests."

Write reports, papers, journals, etc. Students in about two-thirds of schools (14) described their opportunities to use word processors for writing reports, essays, compositions, journals, brochures, notes, and so forth. In the words of one student, "Most of what I do on the laptop is taking notes. We take a lot of notes. It's so much easier than doing it on paper. You're not going to lose it, you're not going to forget about it or tear it up." A student in another student explained the value of laptops for writing this way:

> Like before, we just wrote it on paper, but now they give us more ideas. You go to a certain website. There's a design on that website, and it's like you have to include stuff in your writing, like pictures from the Internet and stuff, and it makes it more fun to write papers.

Learn basic factual information. At nearly two-thirds of schools (14), students explained their use of laptops to learn basic subject-area information. For example, students used their laptops (i.e., word processor) to define vocabulary words, practice grammar activities, do science worksheets, type spelling words and definitions, or to learn about the writing process. Other students explained the use of skill-building software to practice core-subject skills.

Play educational games. At about half of schools (12), students said that they played games on the computer. Games at school, however, typically supported their academic subjects. As an example, students in one social studies class went online to a site called Fun Brain to play a game on states and capitals. A sixth grader explained how it worked:

> It asks, "Where is Oklahoma?"—and it has a map, and you push Oklahoma, and it says, "No, that's the wrong answer," and it shows you where it is.

Access informational resources. Students at two schools talked about their access to electronic informational resources, such as the World Book Encyclopedia, Dictionary.com, and Encyclopedia.com. Resources provided pictures, information, maps, and a dictionary. One sixth-grade student extolled the value of up-to-date information: "If we want to find more information on what we're doing, we can go sometimes, a lot of times, to an Explore website to look at the update stuff instead of like a textbook."

Enrich non-core subjects. Only a few sixth graders reported using laptops in non-core subjects. Students at three schools described their opportunities to use laptops in music. In one middle school, a student explained how she used a program called EMT to learn about music theory (B flat major scale) and Final Notepad to make music: "It gives you a beat, and you play to the computer, the computer grades you, and then you have to send the grade to the teacher through First Class."

Students in a different school had used a program called SmartMusic in band class to record themselves playing their instruments. In yet another school, students searched the Internet for the names of artists from long ago and used GarageBand to make up their own music. Another student described laptop use in art: "Like, in art we use a little education website and like art websites and I take pictures and print them, and then we have to make our graph, and we draw them out."

Because many teachers felt unprepared in the first year to fully utilize resources included in the technology immersion packages, they depended on curricular and assessment resources with which they were more familiar or resources that were more closely aligned with their immediate instructional and curricular needs. Teachers frequently looked to the Internet for instructional and learning resources and used productivity tools, such as word processors or presentation programs, to enhance assigned tasks.

Manage Assignments and Materials

In the first year, it appeared that only a few teachers began to use technology as a tool to manage class assignments and the submission of student work. One sixth grader explained how it worked at his school.

> Some teachers have their websites, and they'll put assignments on there so you can click on the assignments, or have just the websites, so we can do it all there.

In other schools, teachers reportedly posted student homework assignments on eChalk, a data communication tool included in their TIP package. One student explained, "That's where our work is at usually. In eChalk we have our thing, and our teachers can send us our work if we're sick at home." Teachers at half of campuses reported that they used eChalk to communicate electronically with their students about lessons or assignments. Other students talked about sending assignments to teachers through email or putting it in their "drop box."

Communicate with Teachers and Peers

Laptops also seemed to be used infrequently for communication. Sixth graders at two schools said they used their laptops during free time for email. One student in a middle school explained: "Sometimes when we have free time we have something on there, iChat. We will talk to our classmates on iChat. That is really fun!" Students at other schools, however, did not mention their use of laptops to communicate with either their teachers or classmates.

Technology Use Frequency

Nearly all of the teachers reported that they integrated technology into their lessons at least some of the time. Only one teacher in the focus groups, a math teacher, said that she did not attempt any technology integration at all during the first year. Teachers at three campuses, however, reported using technology very little, primarily because of time constraints. One teacher explained:

> We're so involved right now with teaching TAKS. So after April 19th, maybe we'll get to experiment a little bit more and branch out more than what we've been able to do up until now, because we've just been rampant because of time.

From a student perspective, laptop use in classrooms was the teacher's prerogative, with students' noting teachers who "hardly ever" used laptops, and other teachers who used laptops "a lot" or "every day."

Students also noted inconsistencies in laptop use by content area, and they said mathematics teachers used laptops the least. Typical comments about laptop use in mathematics included these: "We don't use them at all" and "We never use it in math." In only one instance did a student report using laptops almost daily. Math teachers confirmed that they used laptops less frequently than other core-subject teachers. Barriers to integration cited by teachers included a lack of high-quality, challenging math resources, a lack of time, and concerns about diverting class time from TAKS preparation. As a teacher at one school observed, "We have to balance integration along with making sure our kids are prepared…and especially in math, we always feel like we're running out of time."

For the other subject areas, student and teacher laptop use appeared to vary across schools as well as for individual teachers within particular schools. For example, in describing English language arts classes, a student in one school said, "We hardly use it. We usually use the book." In contrast, students at another school reported: "We use it a lot." Students at a larger middle school who had different teachers described diverse experiences. One student said, "We use it a lot in English," while another said, "Mrs. [name] doesn't let us use our laptops…She's mean…She likes it quiet." Teachers at about two-thirds of campuses (15) said that they integrated technology into their English language arts courses to some extent. A few teachers discussed obstacles to technology integration, such as the need to prepare students for the paper-and-pencil TAKS and poor student keyboarding skills.

In science, some teachers appeared to have embraced laptops while others did not find them useful. Teachers at nearly half of schools reported using a wide variety of resources and programs when they integrated technology into the science curriculum. At other campuses students said, "We barely use them in science except once a week." In at least one school, the use of laptops in science class depended upon the student's assigned teacher. The frequency of laptop use also varied widely in social studies classes. Students in some schools said, "We use it a lot" or "I mostly use it in social studies." In contrast, sixth graders at other middle schools reported using laptops "hardly ever" or "only for projects." Similarly, some social studies teachers said that they used laptops in class regularly, whereas other teachers described their use was occasional rather than routine.

Given that the frequency of technology use in immersion schools and classrooms varied greatly in the first year and that laptop use was infrequent in many classrooms, the sections to follow explain how core-subject teachers who used laptops focused the content of their lessons and assignments.

Technology Use in Core Subjects

Table 5.5 provides on overview of the technology use trends in sixth-grade, core-content classrooms and compares technology use in specific subject areas with classroom use overall. Teacher and student reports of technology use are ordered from high to low by the frequency with which topics were mentioned by respondents during focus groups at each of the 22 immersion campuses. Although there are commonalities in the ways technology was used across all subject areas, there are also noteworthy differences in the frequency or priority placed on various uses of technology in English language arts, social studies, science, and mathematics classes. Brief summaries by subject area follow the table, and a more detailed discussion of technology use by subject area is provided in Appendix C.

Table 5.5. Technology Use Trends in Sixth-Grade Core-Content Classrooms

	All Core Classes	ELA/Reading	Mathematics	Science	Social Studies
More Use	Research assigned topics on the Internet	Learn basic factual information	Take or prepare for tests (TAKS)	Research assigned topic on the Internet and…	Research assigned topic on the Internet and…
	Develop presentations or informational slides	Write (type) papers, compositions or reports	Use educational websites, programs, or games	Prepare reports or make presentations	Generate reports, essays, or presentations
	Take or prepare for tests (TAKS)	Compose journal entries	Use productivity tools (Excel, Word)	Access textbooks electronically	Take notes and answer questions
	Write (type) reports, papers, journals, etc.	Study poetry	Do math projects	Define science vocabulary terms	Create charts, maps, or semantic webs
	Learn basic factual information	Read stories and books	Simulate a concept	Take or prepare for tests	Use SS games or websites
	Play educational games	Take or prepare for tests (TAKS)		Simulate a concept or conduct an experiment	Review for tests
Less Use	Access informational resources				

Note. Teacher and student reports of technology use in core-content areas, with categories ordered high to low by the frequency with which topics were mentioned at each of the 22 immersion campuses.

English Language Arts and Reading

In English language arts and reading classes, students' laptops most commonly provided a tool for acquiring factual knowledge and creating written products. Students at more than half of immersion schools (13) said teachers used laptops to improve their basic knowledge in areas such as grammar, spelling, vocabulary, or parts of speech. Similarly, students in more than half of schools (12) said they used their laptops for writing or typing papers, compositions, or reports. Assignments, according to most teachers, typically involved Internet research on a topic accompanied by the use of a word processor to create a written product or to use presentation software, such as PowerPoint or Keynote, to develop a presentation. In several schools (7), students used word processors in English language arts classes to type personal journal entries on a daily or intermittent basis. Students at a few schools (4) used laptops to write poems. In two schools, students said they read stories on their laptops and answered related questions. In two other middle schools, laptops provided access to background information that enriched reading comprehension. In two schools, students said they used a word processor to type book reports or PowerPoint to make a presentation and share a book they had read. Students in two other middle schools described the use of KidBiz in their English language arts classes. At three schools, students reported using their laptops for tests on English language arts topics or for TAKS practice, and in a different school, students described the use of Study Island for playing games and taking online reading tests.

Mathematics

Teachers at many campuses seemed to be struggling to find ways to integrate technology into the math curriculum. Teachers at about a third of schools (8) reported some use of technology in their math courses—however, teachers at another third of schools (7) said technology use in their math

curriculum was limited or non-existent. When asked about laptop use in mathematics classes, students at about half of schools (12) said they used laptops for tests or test preparation, including tests on the Internet, the TMDS, or TAKS practice tests. Students typically enjoyed the online assessments and believed the "hints" helped them to understand math better. Students in nearly a third of schools (6) mentioned occasional opportunities to use math-related websites, programs, or games. Students' comments, however, suggested that these activities most often filled extra time following the completion of traditional paper and pencil assignments rather than being an integral part of planned lessons. In a few schools (4) sixth graders described ways that teachers used the laptop's productivity tools (PowerPoint, Excel, Word) to support mathematics lessons. Students in three schools described more complex math projects, which had typically been assigned after the completion of the TAKS test in April. Only one student described laptop use for the simulation of a mathematics concept.

Science

The availability of laptops in science classrooms primarily allowed teachers and students to access supplemental information on the Internet on science-related topics. In nearly three-fourths of schools (16), students said laptops provided a means in science class to gather more in-depth information on an assigned topic, and in many cases, to prepare reports or make presentations for classmates. Students at a few schools (4) said they now use digital science textbooks that are accessed either online, from a CD, or saved on their laptop. Students in the same number of schools used laptops to learn science vocabulary by copying and pasting information from electronic textbooks or CDs or searching the Internet for vocabulary definitions and pictures. Students in four schools (4) reported the use of laptops for testing, but unlike English language arts and math, testing in science rarely involved preparation for the state assessment (TAKS). This may reflect the fact that sixth graders do not complete a TAKS science assessment. Students at only two middle schools mentioned the use of laptops for simulating science concepts or conducting experiments, which suggests that these activities seldom occurred.

Social Studies

In social studies classes, similar to science, laptops most often served as a tool for topical research on the Internet, writing, and note-taking. Students and teachers at nearly all schools (17) reported using laptops to access information on the Internet as an extension of topics studied in class. Sixth-grade students at more than half of schools (13) said they used laptops in social studies for reports, journals, essays, or presentations, with information typically caming from Internet searches on an assigned or self-selected topic. Students in about a fourth of schools (6) said they mostly used their laptops in social studies classes for taking notes, typing vocabulary words, or typing answers to questions. In a few schools (3), students described games or activities on websites, and in about a fourth of schools (5) students said they used various software applications to create charts, graphs, maps, or webs for their social studies reports or projects. Students in two schools used laptops to prepare for tests on textbook content.

Taken as a whole, teachers and students used laptops more often and in a greater variety of ways in English language arts, science, and social studies classes. Laptops were used infrequently in mathematics classes, and when used, laptops most often supported testing or test preparation or filled free time at the end of the class period.

Classroom Immersion Challenges

Among teachers who had gotten off to a slow start with technology in the first year, the explanation seemed to center around a lack of guidance for lesson development. Teachers also worried that

teaching integrated lessons would take more time, time that would be taken away from student learning or preparation for the TAKS.

Lack of Guidance and Pedagogical Support

Many teachers seemed to be at a loss when it came to actually integrating technology into their curriculum. Teachers needed ideas for integrated lessons, such as model lesson plans with a list of technology resources and websites attached. For example, one teacher said, "It would be nice to have someone come in and really give you places to go and things to do and lesson plans that would include stuff with technology," A teacher at a different school explained it this way:

> What I need I think most are ideas that somebody else has done that they know works. I would like that because I don't have a lot of time to look up things…I want to be sure that what I'm doing is the most effective thing that I can do, and sometimes I run out of ideas for good ways to use it, and I'm sure there are things out there that it's possible to do that I have no concept of.

Teachers at nine campuses who received support from vendor representatives or trainers reported positive experiences, saying that on-site vendor support was helpful. Teachers at two campuses were especially grateful that vendors would come into the classroom and model ways to teach using the package resources. A teacher at one school thought implementation would not occur until they were able to watch model lessons:

> They could make time to visit the classroom for the technology that is not being used and say, 'Let me do a lesson for you,'…But there is nobody on campus to do that, and I think that is hurting us because we can go to all the trainings that we are offered and be at every single little thing, but if we do not have the support, we can't move forward like we want.

Teachers at the same school also felt that they needed a staff member whose only role was to assist with curriculum and technology integration. Overall, teachers seemed to have received less pedagogical support than they felt they needed.

Lack of Time

Many challenges to teacher instruction focused on the additional time demands technology immersion created. Teachers at about a fourth of schools (5) noted that immersion increased the time needed for lesson planning. According to these teachers, classroom immersion required extra lesson planning time because teachers had to look up websites and other online resources, review for themselves how to use the various software programs, and create "backup lessons" for students who left their laptops at home, or in case of a schoolwide technology problem such as a network outage.

Teachers at one school reportedly had to devote additional class time to teaching computer skills such as keyboarding, and academic integrity guidelines designed to teach students why "cutting-and-pasting" work from the web is unacceptable. Teachers at three schools suggested it would be much easier to work with the laptops if each teacher had an LCD projector in their classroom:

Teachers at four schools also noted that instruction time was often lost to the increased classroom management demands immersion created. Teachers spent class time monitoring student computer use, in order to ensure that students were not using the laptops to cheat, play games, or engage in unauthorized web surfing. Teachers at one school were unhappy that immersion forced them to change the arrangement of their classrooms:

> I had the desks where they were in groups of four, and they can face each other and look at the board and look at each other and work together. Well, now they're in groups of four, but they all face the front because I can stand in the back of the room and see everybody's laptop.

Effects of Technology Immersion

As part of interviews and group discussions, district and campus leaders, teachers, and students were asked to describe the first-year effects or impacts of technology immersion. Findings below portray their views on schools, teachers, and students.

School Effects

New Technology Resources

District and campus administrators, teachers, and students expressed gratitude for TIP grants and the infusion of new technologies that moved their campuses toward expectations for the 21st century. Individuals often viewed new resources as a mechanism for changing teaching and learning to better meet the needs of middle-school students who are accustomed to more interactive, digital experiences.

One-to-one laptop access also was seen as a way to help students acquire the kinds of knowledge and skills that will be required for future success in high school and college, and to make students more competitive in the job market. One superintendent noted that TIP was leveling the playing field for students in terms of college and employment prospects:

> Had it not been for TIP—95 percent of the students are low-socioeconomic—they probably would not have come in contact with a laptop computer probably until college or possibly when they become employed at a job that requires them to use a laptop.

Teachers at six campuses said that increasing students' technology skills would give students competitive edge in seeking employment and gaining admission to post-secondary educational opportunities.

Equitable Access to Technology

Many also saw TIP grants as a way to level the playing field for students from low socio-economic backgrounds. TIP grants were limited to schools that served predominantly students from economically disadvantaged families, and with the provision of laptops came a sense of equity that was palpable to school administrators, teachers, and students alike. One teacher explained:

> It puts everyone—no matter what your socioeconomic background—on a level plane. They all have access to the same thing whereas before if you asked [students] to look up something, some could go home and go to a computer, and others couldn't. It's not their fault, and it's not our fault. But now they're on the same playing field. They've all got the same opportunity.

A superintendent noted that "[TIP] has cut across racial and socioeconomic lines … everybody in the middle school [has] a laptop computer, and so it's been a wonderful equalizer in the classroom." The sense of equity was not lost on students, as one sixth-grader pointed out, "Now everybody knows how to use the computer."

New Policies and Procedures

New rules…The introduction of laptops also challenged school administrators with a variety of unanticipated discipline issues. As one principal put it, laptops opened up "a whole new realm of disciplinary reproach." In addition to accessing inappropriate websites, new offenses included sending inappropriate emails, exchanging answers to assignments and other forms of cheating, downloading music and movies, and poor laptop care. In response, some campuses prohibited student downloads of games, music, or movies, and others restricted student-to-student emails, or what one principal called "high tech note passing."

Students also commented on the changes to campus rules, noting that administrators often amended policies as they became aware of new infractions. Students at one school explained:

> [School administrators] pay more attention to the rules on our laptop towards what we're doing than the rules they had at the beginning of the year, like dress code and stuff, even though they're still strict on it. But they pay more attention to the laptops now and make sure we're taking care of them…There's more consequences to when you do things that aren't appropriate with the laptop. Then you get in trouble…The whole school system has mostly changed now. They're [administrators] more high-tech. They are paying attention more to you because you have the laptops so they're just more alert.

Students mentioned rules regarding food and drinks, email, downloading, instant messaging, and visiting inappropriate websites. However, as students explained, not everyone obeyed the rules:

> A lot of people are getting in trouble with them…Students do get in trouble more often because they're misusing the laptops. They're going to websites that they're not supposed to be going to and doing things on their computer like burning CDs or something like that.

…**And new consequences.** For most students, the penalty for a laptop infraction was laptop confiscation. One student recalled, "I remember when I got mine taken away. I started downloading Yahoo! Messenger." Another student added, "A lot more people have been getting in trouble and getting their laptops taken away because people have gotten games or people have gone on bad websites or something." Students in still another school lost their laptops if they did not meet their reading goals.

Principals at half of immersion campuses said that they addressed student misbehavior by confiscating laptops for a period of time or restricting home laptop use. For the most part, administrators did not appear concerned that laptop confiscation deprived students of a learning tool. Instead, they saw laptops as a disciplinary lever. As one principal explained, "If you want to punish [students], you take their laptop." The principals asserted that confiscating laptops penalized students because they were forced to do "everything by hand" and their homework took longer. A further consequence of laptop confiscation was to burden classroom teachers with the need to plan alternate activities for students without laptops when instruction incorporated technology, and some principals required teachers to maintain parallel sets of lesson plans.

Improved Communication

In spite of some restrictions on student-to-student email, principals on seven immersion campuses said that laptops had positively affected communication within the school. Teachers communicated with students via email, posted their assignments online, and used electronic drop boxes for homework. The use of email also facilitated more frequent and open communication between students and school administration. Principals reported receiving student email addressing issues related to school dances, schedule changes, and students' views about administrative decisions.

Staffing Changes

Principals at five campuses indicated that TIP had affected staffing. On one campus, some veteran staff members chose to retire rather than undertake TIP, and four principals said that TIP complicated hiring decisions. They explained that new teachers lacked training and would have to "buy in" to the program.

Teacher Effects

Teachers across immersion campuses said that TIP implementation required an extraordinary commitment of time and effort. As one teacher explained, "[TIP] made me feel like a first-year teacher all over again." Teachers reported that learning to use the package resources and to integrate laptops in instruction had been difficult, but with time they had gained confidence and improved their ability to use laptops.

Effects on Individuals

Increased technology proficiency and comfort with technology. Teachers at each immersion campus said that greater proficiency using technology and increased comfort using laptops for instruction was the greatest effect of first-year immersion on teachers. Acknowledging their growth, teachers in one focus group said:

> And to look back from where we started, where [teachers' names] were computer illiterate, to where we are now. We feel comfortable with them, and the kids feel comfortable. So we have made a lot of progress even with ourselves in this immersion.

A teacher on another campus noted her progress:

> I think, initially…[it takes] me longer to plan. But once I find the resources and I'm accustomed to using them and I know which ones match up with my TEKS and my objectives for the TAKS, I think it'll make a much shorter amount of time for planning in the long run. So I'm looking at it now as a learning curve. Once that learning curve is over, it should just be right on target every time.

Teachers on another campus noted that it had taken the entire year to get comfortable using technology and hoped they would not be judged on first-year outcomes. Principals agreed that teachers' comfort level with technology had increased over the course of first-year implementation, adding that more time was needed in order to fully integrate technology into the curriculum and to incorporate package tools.

Less resistance than anticipated from veteran teachers. District and campus-level administrators (13) stated that after some initial apprehension teachers had responded positively to technology immersion. Administrators in five districts said they expected resistance from veteran teachers but were surprised when experienced staff embraced the project. One district-level administrator noted:

> Our second milestone was in seeing actual usage and integration [of technology]. You can walk on those campuses and veteran teachers, who I thought might not readily adopt the technology and find it—you know, "Oh, here's another thing we're going to have to do"—type attitude, I've seen just the opposite. I've seen a high level of adoption, especially by some of our veteran teachers, and even some of our very active teacher union teachers.

A principal within the district had the same view:

> A couple of my teachers that are veteran teachers, ready to retire, who I thought would maybe be the most reluctant to get involved, have been my total cheerleaders. They just see a whole new world.

And a principal in another district shared a similar experience:

> We thought some of our more experienced teachers would be more reluctant than some of our new ones, and that really did not turn out to be the case…The experienced teachers saw how much better things could be from classroom management in terms of moving forward with assignments.

Effects on Instruction

More student-directed research. Across immersion campuses, teachers said that TIP had changed their approach to classroom instruction. The most prevalent change described by teachers was the use of online resources for student-directed research projects. Teachers felt the convenience of individual student access to laptops was a great advantage over scheduling time in a computer lab and that students were able to pursue research topics in much greater detail. One teacher explained:

> You are just able to expand a bit on what you are doing. In my class, for instance, if we are doing the Alamo or the Revolutionary War, then we can … extend it a bit further and really—the book might mention the Boston Massacre, just a couple sentences about it, but then we can really get into it…research it a little bit deeper.

Sixth-grade students at more than half of middle schools (13) expressed their enthusiasm for opportunities to use Internet and other technology-based resources to conduct research for class assignments. One sixth-grader recalled, "The most interesting [project] to me was one about our countries and history…Because we had our own countries and you found out stuff you never knew before."

Students also said laptops enabled them to pursue their own educational interests. In one school, students said that a teacher allowed them to research educational topics during spare class time. One student described searching for information about becoming a veterinarian, and another searched for college information, explaining, "Like right now, even though we're small and young, some of us are looking for colleges, and you could research one, and that way you don't have to rush and everything."

Principals on five campuses also commented that the students' ability to do research had improved. They said that laptops eliminated the need for students to visit the library or to share books in order to study course topics.

Increased monitoring of student work. Both principals and teachers noted that increased monitoring of student work was a necessary part of instruction with laptops. As one teacher explained:

> The hardest thing for me to do is control that [students] are staying on task at all times because it's just one punch of the button, they can be on a game and you can turn right around and they'll be right where they're supposed to be.

Principals on eight campuses underscored the need for teachers to monitor students' classroom laptop use. Principals noted that students appeared more engaged, but that "[they] may be engaged in something other than what the teachers want them to do." Three principals said that teachers rearranged furniture to accommodate increased monitoring of student work.

A principal on one campus said that teachers were irritated by the amount of time they spent monitoring laptop use. Another principal expressed a desire for equipment that would improve teachers' monitoring capabilities, and another said that his campus offered training in laptop monitoring skills for both teachers and parents. Teachers on two campuses expressed a desire for computer-based management tools that would permit the monitoring of students' laptop use from their own computers. "That way I can sit at my desk and watch what [students] are doing," explained one teacher.

Student Effects

Preference for Laptops over Textbooks

Across campuses, students expressed a preference for laptops over textbooks, noting that laptops permitted access to broader and more current information and enabled them to manage assignments more effectively. "I think the laptops are great for information that you can't find in books," said one student "They're up-to-date on the stuff that books don't usually have." "It's easier to find what you're looking for when you're trying to look for research," said a sixth-grader on another campus, "It is way more interesting than just opening a textbook and reading. It's more updated." Another student said, "It gets boring reading a book and doing it on paper, but if you just do it on the computer, it's a lot faster and you can do it easier, and keep it in there so it doesn't get erased. It's just like having your whole book on a computer."

Greater Access to Information

Teachers also appreciated that laptops held benefits not found in textbooks. As one teacher explained:

> [In the past] I was always pulling things from everywhere. And to have all this at my fingertips is just wonderful. [The laptop is like] a textbook that has more than I could ever touch in I don't know how many years.

Teachers on four campuses commented that the broader access to information offered by laptops allowed students to expand their world views. Teachers in one focus group explained:

> [Laptops have] broadened the opportunity for discussion because kids are going to different websites. And then when we talk about a current event, they each have their own input from a different site that they've seen, and they're not forming their opinions from just one newspaper article.

Teachers in small rural communities were particularly appreciative of this aspect of laptop immersion:

> I think it's important in small town like this… because we don't have museums they can go to, and so many of them don't leave [town name] that often. So [with laptops] they get to see things that they will never ever actually get to see and experience. They can do that online.

New Resources and Learning Tools

In addition to enabling broader access to information, laptops contained learning tools and programs that provided students with valuable resources that reshaped their approach to class work and improved their study habits. One sixth-grader explained how laptop tools helped him to improve his organizational skills:

> There's *iCal* on our computer so we can remember that we have homework or the alarm on the background for every class…Like if you have a little appointment or if you have to write a book report on your computer, you can just set the timer whenever you get home, and it'll ring to remind you.

Students at about a third of schools (7) pointed to the benefits of using productivity tools such as Microsoft Word, PowerPoint, and the AppleWorks suite of programs. Students said the use of productivity tools changed the nature and improved the quality of their school work. One described a change:

> Whenever we do reports, before the laptops, we used to have to do it like on poster board, but now we can just do a PowerPoint over it. It is a lot funner [sic] and easier way to do it.

Some students said that special laptop features supported greater understanding. For example, students believed that information accessed online was written in more comprehensible vocabulary compared to the words in textbooks. One student liked that when he used his laptop he could "click" on a difficult word and "get the definition." Students at a few schools (4) said they used laptops outside of school in order to complete assignments and homework, study, and use the Internet.

Word processing. Across immersion campuses, students and teachers said that word processing was an improvement over handwritten assignments. One student explained:

> Laptops are very useful to have around when doing class assignments because I type faster than I write. So when we got the laptops, I could get my assignments done a lot faster because I can type pretty fast. It's quicker to do assignments than writing them down.

A teacher on another campus said:

> No matter what the format is, [students] are going to express more if I give them the opportunity to use a laptop than if they use paper and pencil. And you can't ignore that."

Students' comments tended to emphasize the benefits of the spelling and grammar functions of word processing programs. Students in one focus group explained:

> You can find out if you spelled a word wrong; it will underline it and you can go to Tools and Spelling and Grammar and it will give you the word, how to spell it…And if you don't like how it's positioned, like if you put one too many spaces or didn't capitalize it, it will underline it in green.

"[Spell check] helps you with your spelling a lot," said a student on another campus, "and when you go over it again, you'll know how to spell it and you will not go up to spell check." Students on still another campus said that their use of spell check led to better grades in spelling. However, teachers on at least one campus worried that TAKS scores would drop because students relied too heavily on help from spell check and would have a hard time transitioning from keyboarding to a paper-and-pencil exam.

Four principals also commented on students' use of word processing programs, noting that the programs reduced the time teachers spent reading illegible handwriting and checking students' spelling.

Keyboarding skills. Some students said using laptops caused them to become better typists. "You can learn to type faster," said one such student, "Like right now, if we didn't have the laptops we'd have to wait to schedule [a class] to learn how to type." However, both students and teachers recognized that students' weak keyboarding skills slowed the pace of technology-based lessons "Some of the kids that are slower," a teacher explained, "They're slower even on the computers than they are actually doing it on paper." Despite the current state of their typing skills, students were savvy to the broader implications of computers for writing. As one student predicted, "…probably in about a century, I doubt anyone's going to be writing on paper."

Enhanced Capacity as Learners

Student views. In more than two-thirds of schools (15), students reported that laptops had made them better learners and improved their academic performance. Such students said they were able to learn more, easier, and faster when assignments incorporated laptops and that laptops checked their spelling, assisted them in solving math problems, and provided games that supported classroom instruction. Students also felt that laptops afforded them greater opportunities for review. One student explained:

> Instead of making note cards over the review, the teachers do PowerPoints to where we can go home and can study the PowerPoint over and over again, and however many times we want to study. It is a lot funner [sic] way to study.

On another campus, students said that laptops improved students' writing grades because they turned in better researched and more complete essays and:

> Because we can look up more information on the Internet, and when we write the essays about something, it helps us, and we get better grades on the essay than we usually do when we hand write it.

And on another campus, a student explained how greater differentiation of learning provided by online resources led to 20 to 30 point grade increases in two of his classes:

> The websites help you learn more than a teacher can ever teach you, kind of...Sometimes if you don't understand the teacher, you're like, 'What do I do?' If you cannot talk to a person and ask—'How are you supposed to do this?'—on the Internet, it gives you a hint, and it kind of explains the answer for your, and if you still get it wrong, you click *Check Answers*, and it will say wrong and how it was wrong.

Teacher views. In spite of student reports of improved grades, most teachers were reluctant to link technology immersion to improvements in academic achievement. Faulting the distractions introduced by computer games, Instant Messaging, and other laptop inspired off-task classroom behavior, teachers at three campuses said that students' grades dropped during first-year implementation. Teachers noted, however, that the drop in grades was likely a temporary effect produced by students' initial excitement over laptops:

> I think it was that they were so excited about getting the laptops that they weren't doing their homework; they weren't getting their work done...But I think right now they're like us— they were learning some skills that they didn't know, and I think that we're going to see more quality next year.

On another campus, however, teachers predicted that immersion would lead to improved TAKS scores. "There was a lot more interest in the content areas," the teachers explained, "Kids saw math in a totally different way, they saw reading in a totally different way, because we were able to go into the websites and read stories along with the computer."

Increased Technology Proficiency

Teachers and principals at nearly all campuses said that technology immersion had a positive effect on students' technical skills. Both teachers and principals were impressed by how quickly students learned to use technology resources and said that students frequently mentored teachers in the use of package tools and equipment. One teacher explained

> [Students] know a whole lot about those computers and stuff, more than I expected they would know, and they can do stuff—this week when we had the server issue, these kids were working offline, and me, just complaining and mouth just running about, "I can't get online and get stuff done," and here they backdoored it, and they're getting online and getting stuff done.

Several principals said they encouraged teachers to rely on students when they encountered difficulty using laptops. "Ask the kids," one principal advised his struggling teachers, "They'll be glad to show you and help you out." Teachers also noted that students tutored one another in the use of laptops.

Students in half of sixth-grade focus groups said that technology immersion had provided them with opportunities to learn and practice with technology and that their skills had improved. They said they

learned how to create folders, save their work, do research, and use features of package programs. One student explained, "[The laptop] helps me understand better what each program is like and how to use it."

Greater Self-Responsibility and Self-Regulation

Providing students with individual laptops creates an educational environment in which students must demonstrate greater maturity and responsibility. Students must learn to care for valuable equipment, use laptops appropriately at school and at home, and make appropriate behavioral decisions.

Responsibility for laptop care. Both teachers and principals expressed concerns about students' ability to care for their laptops. As one teacher explained, "[You see] kids walking in with [laptops] and you think, 'Oh, my gosh, should you even have that in your hand?'" But, for the most part, teachers and principals were pleasantly surprised by the responsibility students demonstrated with respect to laptops. One principal commented:

> We thought we would have a lot more trouble, a lot more breakage, and a lot more irresponsibility. The kids have just really amazed me because they have been responsible.

Noting the apprehension over students' ability to be responsible for laptops, a district-level administrator for one immersion campus explained:

> In terms of the students, I think that there were a lot of people that were real afraid about turning loose that many expensive computers into the hands of all of these students. It's always been my philosophy that kids will live up to your expectations, and I never had a moment's doubt that they would handle it fine, so I would say the greatest success has been how great the kids have managed this thing. I think the students have just done exceptionally well.

Students included in some sixth-grade focus groups reflected the view that student ownership of laptops encourages greater responsibility. "My responsibility to take care of the laptop [has changed]," said one such student, "I've been more careful." A student on another campus said, "It's taught me a bit more responsibility because sometimes I'll forget to charge my laptop, and I'll feel mad at myself and not have enough power by the end of the day." A sixth-grader on a third campus explained that the lessons of laptop responsibility informed other areas of his life, "I can have more responsibility with other things because I take my responsibilities with the laptop."

Only one principal complained of student irresponsibility, but even then, conceded that the school experienced few problems with lost or broken laptops.

Self-regulation of behavior. Laptop use presented some students with a dilemma in choosing between completing assignments and playing games or engaging in other non-academic pursuits. A teacher explained, "[Students] can't stand the temptation of having a device where they can play games, Instant Message, shop, whatever. We try to control it, but it's very tempting for them."

Students described the conflicts first hand:

> Like when you're doing an assignment and then you're on the Internet or something it's tempting you to go do something else that you want to do, like if you see other people doing it. That's been hard.

A student in another school described a similar predicament:

> When [the teacher] says do your work, he assigns us something, I do my work. But it's weird. It's hard to resist from going on the Internet looking up pictures—not bad pictures—I mean normal pictures.

Another student described the challenges of learning self-control with respect to computer games:

> Like, they're fun, but then you have to make a line between games and homework…You're going to want to be like, 'Oh, I can do it later,' and then you'll play games when you really need to do the assignments.

Greater Engagement in School and Learning

In spite of some students' tendency to engage in off-task behavior using laptops, school administrators, teachers, and students across all immersion campuses said laptops had increased students' engagement in learning. An assistant superintendent in one district described the effect of laptops:

> If there is one thing that I could say was the greatest success is … the kids are so much more involved in the learning. They are so much into the learning process because of the laptops. So I think that's probably the greatest thing-how much more involved the students are in the whole learning process.

Principals said that students were excited to come to school and sought "every free minute that they get in each class" to use the laptop. They said that students worked on their laptops during lunch, at basketball games, and while waiting to be picked up for the dentist. Teachers noted that students were more interested and engaged when class activities included laptops and described changes, including more on-task behavior and fewer complaints as well as greater participation by "troublemakers," shy students, and English language learners.

Students spoke of their increased engagement, describing the behavioral (e.g., attention) and emotional (e.g., interest, enjoyment, self-esteem) dimensions of their learning.

Attention. Some sixth-graders said that they paid more attention when class activities included laptops. One student explained:

> I like them because whenever we're in history and whenever we're not on them, we have the books out and nobody's paying attention. Everybody's tired by reading the book, but whenever we get on our laptops, we love to get on our laptops, because it's not boring or anything.

Another student added, "You get entertained. Like, you're looking at the screen, and they're reading. You can read it alone, and nobody's hearing you if you make a mistake or not." Some students said that laptop use motivated them to stay awake in boring classes. "You're not falling asleep in class when your teacher is talking too much," said a sixth-grader in one focus group. "I know a girl that always dozes off and never pays attention," said a student on another campus, "… but she always [pays attention with] the laptop."

Interest. In addition to increased attention, some students reported that laptops led to greater interest in subjects that incorporated laptop use. One student explained:

> Social studies is a difficult subject. It's not really interesting, and you hardly want to learn about history and things like that. With the laptop, it makes it fun because you go back and it just makes you…like you're taking a step through time.

Teachers noted that students who had been "pretty apathetic" in their approach to coursework demonstrated greater interest when class activities included laptops.

Enjoyment. Students said they enjoyed class activities that incorporated laptops and that enjoyment translated into improved learning and greater engagement in their schooling. "I'm feeling a lot better getting up in the morning, going to school, knowing that we might actually have some fun today, doing stuff with the computer," explained one student. "Some kids actually want to come to school because it gives you something to look forward to," said a sixth-grader on another campus, "It's just better than pencil and paper all the time." A student on another campus advised, "[Laptops are] more fun, and students will learn more when they're more entertained."

Self-esteem. Principals on eight campuses said that use of laptops had produced notable increases in students' self-esteem, and teachers said students took greater pride in their work when they used laptops. One teacher explained:

> And I think the pride that they take in their work, I've seen some stuff that I know I never would have seen it before, and of course, the end product. Whereas before they would have cut out from magazines and cut and paste, with ClipArt they've created brochures; they've created posters.

Students' pride translated into improved understanding of their own abilities and prospects for employment. "We're a lot smarter" replied one student when asked if she had changed because of laptops. "It prepares us for the future," said a student on another campus, "because most jobs … have computers involved and technology."

6. Summary and Conclusions

The study of technology immersion employs a quasi-experimental research design with middle schools assigned to either treatment or control groups (22 schools in each). While the overarching purpose of the study is to scientifically test the effectiveness of technology immersion in increasing middle school students' achievement in core academic subjects, the evaluation also aims to examine the relationships that exist among contextual conditions, technology immersion, intervening factors, and student achievement. Data gathered through site visits to all participating middle school campuses in fall 2004 and spring 2005 allowed an in-depth examination of campus conditions, school and classroom activities, and educational roles and processes through interviews with key personnel, focus groups with teachers and students, inventories of technology resources, and reviews of documents. Major findings presented below first portray existing baseline conditions at both treatment and control schools, explain treatment campuses' initial steps in implementing technology immersion, and describe campuses' readiness in fall to undertake immersion. Next, we present findings on first-year implementation, and finally, describe effects of immersion on schools, teachers, and students.

Baseline Characteristics of Middle Schools

This study's design compels researchers to demonstrate that detected effects are not attributable to pre-existing differences in comparison groups. Thus, one purpose of fall site visits was to gather baseline data on existing conditions at both treatment and control campuses. Researchers documented the nature of technology access, the level of technical and pedagogical support, teachers' prior participation in technology-related professional development, and the prevailing uses of technology by teachers and their students.

Technology Access

Treatment and control campuses at baseline had comparable access to school and classroom technology. Teachers, on average, had few computers in their classrooms in fall (less than three) and few technology resources, such as printers and LCD projects. Computers were typically located in computer labs, technology applications classrooms, or libraries. Some campuses had mobile carts with sets of laptop computers available in a central location for checkout. Although technology access varied little between treatment and control schools, some classrooms and campuses within each group had more technology.

Teachers at all schools believed they had too few computer resources in classrooms for their students to use. Still, some teachers in both treatment and control schools seemed to be very comfortable with technology and utilized it regularly in their classrooms. Computer labs were used in a similar fashion across groups, with teachers taking turns scheduling time for their classes. As a whole, teachers reported significant hardware-related problems with computers, and they complained about undependable and slow Internet access in both labs and classrooms. These conditions discouraged many teachers from using technology in their lessons.

Technical and Pedagogical Support

Although the extent and configuration of technical and pedagogical support varied across treatment and control campuses, most had general technical assistance and at least some support for curricular integration. Analyses of campus support mechanisms revealed no clear differences between treatment and control campuses. All campuses appeared to have one of a few models of support, including assistance from a multilevel team (various people on campus and at the district sharing responsibilities), a coordinator with various roles (a single person on campus in charge of all support operations), part-time support (reliance on part-time or off-campus support providers), or no direct support (no clear mechanism for support). Direct support for and control over infrastructure and hardware were typically concentrated at the district level or with other off-campus entities, whereas campus personnel more often provided troubleshooting, software support, and assistance with classroom integration.

Both treatment and control campuses faced similar technical support challenges, and ongoing technology problems created barriers to access and use. Even though treatment campuses reported shortages of experienced technical staff more often than control campuses in fall, this difference may have reflected their heightened awareness of personnel issues as they prepared for immersion. With laptop computers en route, technology coordinators at several of the smaller treatment campuses realized that technology immersion would increase the need for a highly experienced technology staff that could address immediate technical needs, image and inventory computers, and be able to provide technology integration advice. Many of these technology coordinators wore a number of professional hats, and knew that they could not handle all of these technology integration needs by themselves.

Professional Development

Technology-related professional development was widely available to most teachers, but the training content generally focused on computer literacy rather than curricular integration. In recent years, technology-related training for teachers at both treatment and control campuses most often centered on basic productivity software (e.g., word processors and spreadsheets), educational software, and Internet applications. Training on integrating technology into the curriculum was available, but varied from in-depth approaches, such as the Intel Teach to the Future program, to informal resource sharing, such as campus websites devoted to sample lesson plans using technology. A common characteristic of technology training at all campuses was the variety of professional development opportunities available. Teachers generally selected the training that was most convenient or useful for them, although several schools had specific technology proficiency requirements for teachers.

Teachers at treatment and control campuses experienced similar technology professional development needs, barriers to participation, and interest in one-on-one assistance. Teachers cited insufficient time to participate in professional development events, a lack of time to practice newly acquired skills, and insufficient classroom technology as major deterrents to their involvement in professional development. Although teachers mentioned numerous training needs, many requested more help in integrating technology into the curriculum, and they wanted technology-savvy trainers who could model lessons, serve as an on-campus resource, and provide one-to-one assistance.

Teachers wanted ongoing personal support from trainers with practical classroom experience. Teachers wanted trainers with a teaching background to assist them with the task of integrating technology into the curriculum. Teachers wanted trainers to model lessons, and they wanted a support system that included in-class coaching or team teaching for initial attempts at integration, as well as on-campus experts to answer questions about software resources and to troubleshoot hardware problems.

Teacher and Student Technology Use

In fall 2004, teachers seldom incorporated technology into their lessons because they had few computers in the classroom. Teachers at both treatment and control campuses in fall believed that technology had limited value because all students in their classes could not access the computers at the same time. Moreover, some teachers did not incorporate existing technology into their lessons because they felt inadequately trained. When used, classroom computers were primarily a tool for teachers to complete administrative tasks, such as maintaining gradebooks, reporting attendance, sending email, or accessing the Internet. Teachers occasionally had their students access the Internet or use educational software programs or websites either in the classroom, computer labs, or library. Only a few teachers were integrating technology into their lessons to a great extent.

In fall, students at treatment and control campuses had similar technology access and used technology in comparable ways. All students had technology available to them, either in the classroom or in an on-campus computer lab. Students' use of educational programs typically targeted the core subject areas. For example, the Accelerated Reader program was mentioned frequently. Principals and teachers also described students' use of software applications, such as Word, Excel, or PowerPoint. Educators said that students' assignments sometimes included Internet-based research, electronic presentations, and word processing. Although the range of student technology use was similar across treatment and control campuses, students at some campuses used technology much more frequently.

Initial Steps toward Technology Immersion

Activities undertaken by districts and campuses in the early phases of a school reform initiative may influence subsequent progress toward institutional change. For this project, the nature of the competitive grant process, initial relationships with the immersion package vendors, and emerging policy and funding issues are noteworthy.

The timing of the competitive grants affected the application process and staff participation. As a way to increase the number of immersion campuses, the Texas Education Agency (TEA) conducted two rounds of applications. Six middle schools received awards in May 2004, while 16 middle schools that applied during the second round received their grant awards in July. Consequently, schools in the second round had limited opportunity for broad-based participation in grant development and little time for planning before the school year started. At about a third of middle schools, principals were not involved in the grant-application process, and at most campuses, teachers were not consulted about the decision to apply for the grant. Only three campuses apprised teachers before writing the grant application. As a result, most of the teachers at TIP campuses were unaware of the grant until they returned to school in August. In contrast, one district and campus that applied in the first round pursued a research-based approach. In this district, representatives of the school board, district, and middle school visited an out-of-state district that was implementing a one-to-one laptop initiative. Subsequently, campus teachers received information and contributed to the decision-making process.

Initial progress toward immersion hinged on establishing supportive and dependable relationships with vendors. Because successful technology immersion requires the coordination of the delivery of hardware, software, and sustained professional development, establishing effective relationships as soon as possible with vendors who provided the immersion packages was critically important. Overall, principals at Apple campuses reported positive interactions with their vendor in fall. All of the Apple campuses received timely responses to inquiries, and four of six campuses had either completed or scheduled a portion of the requisite professional development.

In contrast, principals at Dell campuses reported a broad range of reactions. While some campuses said Dell representatives were responsive to questions and requests, other campuses found it difficult to contact Dell by phone or email, or they were still waiting for information. Moreover, only 6 of the 15 Dell campuses had completed or scheduled portions of the professional development to be provided by Co-nect (the Dell professional development provider). Part of the differences in vendor relations may have been due to Apple's greater experience in working with educational institutions. While Apple has been providing technology and a range of support services in the educational setting for many years, Dell was relatively new to the field and had previously focused on providing hardware for schools.

Early on, campus leaders had to address policy and funding issues associated with technology immersion. In fall, almost all principals said they needed to revise policies and adjust budgets to accommodate technology immersion. Entrusting middle school students with expensive laptops required policies that clearly articulated behavioral expectations for both students and parents. After updating policies, several principals said the school communicated laptop and Internet access responsibilities and expectations to parents through presentations, training sessions, and letters. Schools also provided training on appropriate laptop and Internet use for students, but some principals still worried about student responsibility for and safety with laptops.

New demands on school budgets, especially insuring student laptops against damage and loss, were an additional concern in fall. Campuses explored different possibilities, with some contacting other schools that offered laptop programs to inquire about loss and damage history, insurance costs, and approaches to insurance. Middle schools settled on a variety of methods, such as using district and campus funds to pay for insurance, purchasing geographic tracing software, and requiring parents to pay insurance fees. In addition to insurance, local funds were needed at some campuses to purchase more laptops for students, acquire ancillary equipment (e.g., printers, LCD projectors, scanners, digital cameras, laptop cases and backpacks), update the campus infrastructure to support a wireless environment, and secure home Internet access for students. Some principals also undertook plans for replacing outdated laptops or providing laptops as student moved to high school.

Readiness for Immersion and Expected Outcomes

Information collected at middle schools in fall suggested that many campuses were unprepared to undertake a whole-school technology initiative. Lack of readiness was evidenced notably in school personnel's capacity, proficiency, attitudes, and understanding of technology immersion. Still, educators in fall expressed optimism about positive project outcomes.

A shortage of well trained and capable staff jeopardized prospects for adequate technical and pedagogical support at many campuses. Technology coordinators, especially at small campuses, worried about a shortage of well-trained technical staff capable of handing existing hardware and campus needs. Moreover, a few campuses had no formal process for dealing systematically with technical issues. Coordinators feared that problems experienced in the recent past were likely to persist without trained and available support staff. Furthermore, with their initial planning and research into existing one-to-one laptop programs, coordinators had identified a number of logistical issues, including distributing, collecting, and creating maintenance processes for the laptops, which raised their awareness of new challenges ahead. In many cases, coordinators believed that technical staff was already spread thin and that, without additional personnel, adequate laptop maintenance would be difficult, if not impossible. At the same time, however, immersion campuses appeared to be formulating plans for dealing with newly recognized tasks.

Some educators doubted students' ability to care for laptops. Some leaders and teachers did not believe students would be responsible enough to care for their laptops properly. They feared that students would forget to bring laptops to school, would lose or break equipment, or would use the laptops improperly. They cited students past irresponsible behavior, such as failure to bring pencils or books to class, as evidence of students' shortcomings.

Teachers' limited technology proficiency was viewed as a potential hindrance to technology immersion. Teachers' existing technology skills affect prospects for having a fully immersed campus, and in fall, technology coordinators at more than half of campuses expressed concerns about teachers' low levels of proficiency with instructional technology. Likewise, teachers worried about their own lack of skills and experience with technology. Many principals worried, especially, about veteran teachers who were less technology savvy and more skeptical or fearful about technology immersion.

Teachers' commitment to technology immersion was tempered by their anxiety about the increased work load as well as their confusion or uncertainty about the immersion concept. Nearly all sixth-grade teachers felt fortunate to participate in the TIP project but were still concerned about the difficulty of implementation. Teachers were mostly apprehensive about the time and extra work involved in technology immersion, and feared that it would place too many demands on already-busy schedules. Many teachers also seemed perplexed about how technology immersion would actually work in practice. Despite some pessimism, most teachers at immersion campuses expressed excitement about the grant, even if the excitement was mixed with apprehension.

Teachers' enthusiasm for immersion most often stemmed from their perceived benefits for students. Many teachers believed that technology immersion would increase student motivation for school and learning, and perhaps improve academic performance. Several teachers pointed to the laptop's potential for differentiating instruction, which would allow students to work at their own pace. Some teachers also believed that students would improve their technical skills through laptop use, and this knowledge ultimately would improve their chances in the workforce. Teachers at schools serving primarily low-income students also saw a moral purpose and believed the grant would allow disadvantaged students more equitable access to technology and expand their knowledge of the world.

Principals were optimistic about the possible effects of immersion on their students, teachers, and schools. Principals also expressed hopeful expectations for technology immersion. Similar to teachers, they most often cited benefits for students. Principals hoped for higher student achievement and improved TAKS scores. They also expected changes in students' learning opportunities, such as using laptops for research projects, homework, emailing questions to teachers, and receiving tutorials. Some principals anticipated more student-centered learning, with students taking more responsibility for their own learning. Several principals believed the technology might increase student engagement, since the technology better suits the learning style of today's students. Nearly all principals believed that immersion would "level the playing field" for low-income students and their students would be better prepared for the job market and demands of the 21st century.

Principals also expected technology immersion to change teachers. They anticipated improvements in teachers' technology proficiency as well as their instructional approaches. Many hoped that teachers would move away from traditional, teacher-centered methods of instruction towards more small-group, hands-on activities in which teachers act as facilitators. Additionally, some principals believed their schools were blazing new trails and serving as technology leaders for the state and nation. Some principals hoped to increase the volume and quality of communication among teachers, students, and parents; others believed that enhanced parent email communication, school and teacher websites, and computer training opportunities could increase parental involvement at the school.

First-Year Implementation of Technology Immersion

Between March and May 2005, researchers conducted follow-up site visits to each of the treatment and control campuses. Site visits to control campuses verified that little had changed since fall. Technology access and use remained virtually unchanged and campuses continued to pursue their previously declared educational missions. At treatment campuses, researchers assessed the implementation of grant-specified components of technology immersion (i.e., robust access, technical and pedagogical support, professional development, and resource utilization), gauged leadership and parent and community support for immersion, and investigated teacher and student technology use.

Implementation of Immersion Components

Robust Access to Technology

Due to delays in laptop rollout, the amount of time students had their laptops varied by campus, with many students having less than four months of laptop use. Logistical procedures in the awarding of two rounds of grant funds caused later than anticipated laptop rollouts. Most campuses received teacher and student laptops between October and December 2004, but for some campuses, rollouts did not occur until January or February 2005. Thus, teachers did not have their laptops for some early professional development activities and had little time to become familiar with laptops and resources before students received computers. Moreover, students had laptops for an average of 105 days, or only about 60 percent of the 180-day school year. While most rollout delays resulted from the timing of grant funding, others resulted from difficulties in relationships with vendors, campus-level planning, and parental resistance.

Some campuses restricted students' access to their laptops outside of school. Immersion's ubiquitous access to technology calls for access both within and outside of school. This provision generated opposition at some immersion campuses. In the first year, six campuses limited students to in-school use of laptops and two campuses allowed laptops to go home only for special assignments. Moreover, even when students were permitted to take laptops home, access to online resources was limited because many students did not have Internet access at home.

Older middle school buildings failed to support the infrastructure demands of technology immersion. Nearly a third of principals believed their buildings' infrastructure was inadequate to meet the demands of technology immersion. District and campus leaders described network limitations, including poor Internet connections caused by insufficient bandwidth, network failures, slow connections, and bandwidth logjams, which frustrated their efforts at immersion. In some cases, district servers were insufficient for the demands or were subject to district-level management decisions.

Technology access was affected by software, Internet, and hardware maintenance issues. Ongoing software issues, such as forgotten passwords, inadequate Internet filters, and viruses hampered first-year implementation. Most laptop resources required unique passwords, so dealing with forgotten passwords became a persistent and time-consuming issue. Internet filtering was a major and ongoing concern. Technology-savvy students were able to bypass school Internet filters. Some students accessed inappropriate websites, or in some cases, filters worked so well that they restricted access to appropriate resources. Campuses also encountered normal hardware wear and tear, such as keys popping off, scratched monitors, defective chargers and batteries, and occasionally, more severe hardware damage, including broken or cracked laptop monitors, bad motherboards, and broken keyboards. Secure laptop storage was an unanticipated concern for many campuses. Because many of the technical and maintenance issues were unforeseen, school leaders frequently made spur-of-the-

moment decisions to remedy pressing problems rather than following a well planned and strategic course of action.

Technical and Pedagogical Support

Many districts and campuses had difficulty meeting the technical demands of immersion. Even though the grant required each campus to provide dedicated technical support for immersion, the level of support varied widely during first-year implementation. In some cases, the technology coordinator was a full-time position, but in others, it was a part-time position or a split-time arrangement that entailed other teaching or administrative duties. Coordinators provided technical support for a wide range of issues, including managing the distribution and collection of computers, imaging laptops, solving printer problems, addressing log on and password problems, and maintaining hardware. Many coordinators did not have the requisite backgrounds to provide broad-based technical support, so they relied heavily on district- or campus-level technicians, and in some cases teachers with technical expertise, to assist with more challenging problems. Technology coordinators reported that they generally sought vendor support only after exhausting campus- or district-level avenues to resolve problems. Coordinators' views on the quality of vendor support varied.

Pressing technical requirements diminished staff capacity to provide campus-based pedagogical support for immersion. Many technology coordinators expected to spend more time supporting teachers' efforts at classroom and curricular integration in the first year, but responsibilities for technical support and management tasks consumed most of their time. Many coordinators were overwhelmed by the scope of their responsibilities and had spent little time in classrooms supporting teachers' lessons with technology. About half of campuses reportedly supplemented vendor-provided professional development with follow-up sessions for teachers to review the use of package tools, instruct teachers on acceptable use policies, create web sites, conduct WebQuests, use equipment, or assist with integration techniques. At other campuses, there was no formal campus-level pedagogical support.

Teachers most often relied on each other for pedagogical support. Across all immersion campuses, teachers frequently relied on each other for ideas and help with technology integration. In some instances, this support was provided through formal structures such as grade, subject area, or team meetings, while in other instances, teacher interactions were informal encounters in hallways or during lunch. Although teacher collaboration in support of immersion is desirable, most teachers in their first year were unprepared to offer expert advice.

Professional Development

Professional development designed to assist teachers in integrating technology into their curriculum and instruction is a key component of TIP grants, absorbing 25 percent of all funds. The Request for Qualifications (RFQ) for TIP vendors outlined a model for professional development services that included preparation in aligning technology use with standards-based lesson plans, the development of "peer-to-peer learning and support communities," and support for teachers in using technology-based lessons to improve student achievement. Although the vendors selected through the RFQ process provided similar written plans that consistently reflected TIP goals for professional development, in practice, training tended to vary across vendors and sometimes differed from the goals stated in the RFQ. Findings below summarize the professional development experiences facilitated by Dell/Co-nect (15 campuses) and Apple (6 campuses) during the first year.

On both Dell and Apple campuses, first-year professional development emphasized knowledge of immersion package tools and their classroom use. Dell's product trainings spanned fewer days and were generally shorter than those of Apple, and in many instances, trainings in Dell's package products were restricted to teachers' conference periods. Both vendors structured professional development such that a primary trainer was responsible for training activities on individually assigned campuses. Primary trainers had previous experience working as teachers and, in some cases, as administrators in public schools and were able to develop strong relationships with school personnel. Apple's provision of professional development differed from Dell's in that it allowed third-party vendors to provide training in their own package products, which enabled schools to develop independent relationships with product representatives.

Across both sets of schools, first-year professional development was heavily focused on training teachers to use package tools. Teachers on Dell campuses said that Co-nect trainings emphasized the identification of online resources and appreciated that trainers provided links to Websites containing technology-based lesson plans and classroom activities. Teachers on Apple campuses described professional development activities that were designed to assist teachers in developing their own lessons using package resources.

Both Apple and Dell provided in-class support for integration, although the characteristics of classroom training differed. On Apple campuses, teachers and principals described structured activities in which teachers requested assistance and trainers scheduled time working with teachers in classrooms to develop, model, and co-teach technology-based lessons and to provide constructive feedback. On Dell campuses, in-class support was a more informal activity in which trainers visited teachers in classrooms in order to discuss progress and concerns. Although it was evident that classroom visits occurred across Dell campuses, few teachers viewed these sessions as in-class training.

Professional development reportedly increased teacher comfort with technology and led to some changes in classroom practice—a number of teachers, however, had difficulty retaining content or were indifferent to changed practice. The most palpable effect of first-year professional development according to teachers and principals was teachers' increased comfort and confidence using technology in the classroom. Principals were more optimistic about substantive changes in teachers' classroom practice than those reported by teachers. Principals described less reliance on textbooks and TAKS-formatted lessons, and teachers who were more likely to act as facilitators of student-centered instruction. Teachers, for the most part, described the effects in terms of classroom use of resources and equipment (e.g., use of Classroom Connect, netTrekker, websites, search engines such as Google or Yahoo!, eChalk, LCD projectors).

In a few cases, teachers said TIP professional development had no effect on their classroom practices. Similarly, some teachers openly expressed indifference about applying new skills, indicating that classroom use was an individual teacher's prerogative. Additionally, the retention of training content posed an obstacle to classroom application. Many teachers noted difficulty in retaining content when too much time elapsed between training and the opportunity for classroom implementation, or when multiple-day trainings thwarted opportunities for distributed practice. Many teachers also said that pressure over TAKS testing inhibited their efforts at integration.

While initial teacher resistance had subsided on some campuses in spring, gaining teacher buy-in remained a central challenge of implementing technology immersion. Most principals reported some initial teacher resistance at the outset of technology immersion but said that teachers' attitudes improved as they became more familiar with the project. At nearly a quarter of campuses, however, gaining teacher buy-in remained a challenge, and at three campuses, strong teacher resistance hampered immersion efforts. In some instances, student excitement about the laptops countered teacher resistance: "You can't overlook the students' enthusiasm," noted teachers on one campus. To discourage resistance, some principals set requirements for technology use or established clear expectations for the integration of professional development topics into classroom practice.

Resource Utilization

Teachers and students at immersion campuses each received a wireless laptop loaded with digital learning resources. Immersion packages included productivity and communication software, online resources that supported the state's curriculum, and online assessment tools.

Most teachers reported limited use of TIP package resources in the first year. At the end of the first year, the majority of teachers reported that they had not used the immersion package resources to a great extent, with the exception of the productivity tools included as part of the Microsoft Office or AppleWorks suites of programs. Some teachers said they lacked the skills and training to use the instructional and learning resources, while others cited a lack of time or frustrations when resources did not work as expected. Other teachers could not see a strong connection between the programs and improved student learning, especially preparation for the TAKS. Teachers used the online assessments even less frequently than other resources. Some teachers cited technical glitches as a barrier, whereas others said the assessment tools were not well aligned with their curricula. A few teachers who used the assessments, however, appreciated the immediate feedback for students. Teachers and principals who made recommendations wanted more package resources designed to support mathematics instruction and resources aligned with the Texas Essential Knowledge and Skills (TEKS) and TAKS.

Implementation Supports for Immersion

Leadership for Immersion

Although leadership support was not a component of the immersion packages, campus and district leaders played a critical role in the project. Information drawn from district and campus educators describes the nature of leadership during rollout and early implementation.

District administrators' roles and levels of involvement with immersion campuses varied widely. District administrative turnover was one factor affecting leadership for immersion. Only about a third of interviewed district representatives had been involved in the TIP project since the grant application, and a few administrators, who were new to their districts, were not totally familiar with the project. Administrators' level of involvement also varied. Some district representatives reported few formal campus interactions whereas others described substantial involvement in professional development, campus visits, and ongoing communication with campus leaders. In spite of district administrator efforts to remain involved, teachers on some campuses did not believe they provided enough support for immersion.

Principals demonstrated leadership by scheduling planning time, communicating expectations, modeling technology use, marshalling resources, establishing and enforcing policies, and encouraging teacher efforts. Although no one principal embodied all of these leadership characteristics, a synthesis of comments about various principals' leadership contributes to a greater understanding of the kind of leadership that may be needed at immersion campuses. For example, one principal supported collaborative planning by scheduling a weekly, 45-minute planning period for grade-level and subject-area colleagues to plan for immersion. Other principals supported immersion by communicating their expectations, offering verbal encouragement, participating in professional development events, maintaining a visible presence in the school and classrooms, establishing explicit requirements for classroom immersion, and modeling technology use (e.g., electronic presentations, email communication, and online submission of lesson plans). Some principals also worked to ensure that all students would have Internet access beyond the school day.

Teachers valued leadership actions that improved their experiences with immersion. For example, some teachers appreciated that administrators created and enforced policies related to students' inappropriate laptop use, and others thought principals' expectations for classroom immersion should be accompanied by non-critical support for initial efforts. Underscoring the importance of the principal's role in the project, teachers at two campuses with principal vacancies regarded the absence of campus leadership as a hindrance.

Parent and Community Support for Immersion

Community and parent buy-in was another important element of successful technology immersion, and because TIP grants targeted schools defined as high need, a large percentage of families with children in immersion schools did not have a computer or Internet access at home. This lack of experience with technology generated a variety of parental responses to the project.

The level of parent support varied across campuses. And, while most parents viewed students' laptop access as a welcome learning opportunity, some feared financial repercussions or worried about inappropriate use. In the first year, most of the parents welcomed the technology immersion project and appreciated the opportunities that it offered their students to gain new knowledge and skills. At many campuses, laptop rollout events drew unusually high participation from parents who generally were not involved in school functions. On the other hand, a number of parents lacked confidence in their children's ability to care for laptops and worried about their ability to pay for laptop damage or to monitor students' access to inappropriate material. About a third of campuses struggled to gain complete parent support. Some campuses offered information and training for parents as a way to gain parent support for immersion.

Although few respondents discussed the broader community response to technology immersion, two district representatives mentioned enhanced community pride and economic stimulation, whereas four administrators expressed a need to win more community support.

Progress toward Classroom Immersion

Findings to follow portray technology use trends at immersion campuses during the first year, and more specifically, the use of technology in core-content classrooms.

Nearly all of the teachers reported that they integrated technology into their lessons at least some of the time—however, laptop use varied across schools, classrooms, and subject areas. Sixth graders described particular teachers whose laptop usage ranged from "hardly ever" to "every day." Students also noted inconsistencies in laptop use by content area, noting that mathematics teachers were the

least likely to use laptops for lessons. Accordingly, mathematics teachers said their laptop use was limited by a lack of high-quality, challenging math resources, a lack of time, and concerns about diverting class time from TAKS preparation. For other subject areas, students' opportunities for laptop use varied by their assigned teacher. At some schools and in some classrooms, English language arts, science, and social studies teachers embraced laptops whereas other teachers did not find them as useful. Thus, students' laptop use in these subject areas could range from "a lot," to "some extent," to "hardly ever."

In English language arts and reading classes, students' laptops most commonly provided a tool for acquiring basic factual knowledge and creating written products. At about half of schools, students used their laptop computers in English language arts or reading classes to improve their basic understanding in areas such as grammar, spelling, and vocabulary. Students at a similar proportion of schools used laptops for writing or typing papers, compositions, or reports. Internet research on an assigned topic often provided the stimulus for writing. In several schools, students used word processors to type personal journals, and in a few schools, students used laptops to write poems. Students seldom used laptops to read stories or books and answer comprehension questions, but laptops sometimes provided informational resources to enrich students' background knowledge.

Teachers at many campuses struggled to find ways to integrate technology into their math curriculum. Sixth graders at about half of schools used laptops for math tests or test preparation. Students said they took tests on the Internet, completed the Texas Math Diagnostic System (TMDS), or went to a site called Study Island. Electronic assessments often provided a means to prepare for the TAKS. Beyond testing, students at a few campuses mentioned using math-related websites, programs, or games, or using productivity tools for math (e.g., Excel for formulas or graphing). Students rarely mentioned using laptops for math projects or simulations of mathematics concepts.

In science classrooms, laptops most often provided a mechanism to conduct topical research on the Internet. The availability of laptops in science classrooms allowed access to information on the Internet on science-related topics. In nearly three-fourths of schools, sixth graders gathered more in-depth information on assigned topics, and in some cases, prepared reports or made presentations for classmates. Students at a few schools said they are now using digital science textbooks that are accessed either online, from a CD, or saved on a laptop. Other less common laptop uses in science included defining vocabulary terms and taking or preparing for tests.

In social studies classes, laptops most often served as a tool for topical research on the Internet, writing, and note-taking. Internet research was far and away the most common technology use in social studies classrooms. Students and teachers at all schools reportedly used laptops to access information on the Internet as an extension of topics studied in class. At more than half of schools, sixth graders said they used laptops in social studies for reports, journals, essays, or presentations. Laptops occasionally provided a medium for taking notes, typing vocabulary words, and answering questions. Students used laptops less commonly for playing games; creating charts, maps, or webs; or reviewing for tests.

Teachers were challenged in the first year by a lack of guidance, pedagogical support, and time. Some teachers' slow start in the first year seemed to stem from a lack of guidance for lesson development, and a concern that technology-integrated lessons would take time away from students' learning or preparation for TAKS. Many teachers appeared to be at a loss when it came to actually integrating technology into their lessons, and they wanted ideas for lesson plans. Although teachers were grateful for vendors' classroom support, they wanted to be able to watch modeled lessons and believed they had received less pedagogical support than needed. Additional time demands posed

another problem for teachers. Teachers at nearly a quarter of schools said that creating technology-infused lessons required extra time that some were unwilling to give.

Effects of Technology Immersion

Although challenged by many aspects of technology immersion in the first year, district and campus leaders, teachers, and students noted many positive effects of immersion.

The TIP grants fostered the infusion of new technologies that moved middle-school campuses toward expectations for the 21st century. New resources often were viewed by educators as a mechanism for changing teaching and learning to better meet the needs of today's students who are accustomed to more interactive, digital experiences. Laptops also were believed to provide a means for students to acquire knowledge and skills essential for gaining admission to post-secondary educational opportunities and seeking future employment.

Technology immersion provided a way of closing the technology-access gap between economically advantaged and disadvantaged students. Many also saw TIP grants as a way to level the playing field for students from low socio-economic backgrounds. With the provision of laptops came a sense of equity that was palpable to school administrators, teachers, and students alike. One superintendent believed that providing every student with a laptop was a "wonderful equalizer in the classroom." A teacher likewise explained that now, "They've all got the same opportunity." The sense of equity was not lost on students, as one sixth-grader pointed out, "Now everybody knows how to use the computer."

The successful provision of laptops for students requires the adoption of new policies and procedures. The infusion of one-to-one student access to laptops in middle schools caused a host of disciplinary problems that led schools to create new policies and rules for discipline and behavior. Schools dealt with emerging student behavior issues such as accessing inappropriate websites, sending inappropriate email, downloading music and other digital media, and poor laptop care. In the first year, campuses often amended policies as new infractions surfaced. The consequences for laptop rule violations most often was laptop confiscation or restricted use for a period of time. Unfortunately, laptop confiscation deprived students of their learning tool and forced teachers to plan alternate activities for students without laptops.

Teachers at immersion schools increased their proficiency and comfort with technology and changed their instructional approach. Across all immersion campuses, teachers believed their greater technology proficiency and increased comfort using laptops for instruction was the greatest effect of immersion in the first year. And, at some campuses, veteran teachers were less resistant to immersion than leaders had anticipated. Although teachers at many campuses were challenged to learn how to use TIP hardware and software packages, by spring, they were beginning to gain confidence with technology integration. Teachers at nearly every campus described how technology immersion had changed their instructional methods. Most notably, teachers said they now use online resources for student-directed research projects more often. Students generally agreed, especially noting increased opportunities for research on assigned topics in science and social studies classes. With students' increased opportunities to pursue Internet research and use technology-based resources, came a need for teachers to closely monitor students' activities, and some teachers resented the increased classroom management demands that immersion created.

Immersion positively affected student engagement in school and learning. Aside from some students' tendency to engage in off-task behavior using laptops, school administrators, teachers, and students across all immersion campuses said laptops had increased students' engagement in learning.

Principals noted students' greater excitement about school and engagement in laptop use before school, during lunch, after school, and while waiting. Teachers, similarly, noted positive changes in student engagement, especially for special student populations (e.g., English language learners, special education students, or students with habitual discipline problems). Teachers said students complained less and worked more, exhibited improved behavior, and focused on assigned work. Some teachers believed immersion helped motivate students who otherwise might not be high achievers. Teachers and administrators also tied technology immersion to students' increased self-esteem, saying that students felt proud of their laptops and took greater pride in the work they produced.

Sixth graders also spoke of their increased engagement, with some saying that they paid more attention when class activities included laptops. Other students said that laptops led to greater interest in subjects. They enjoyed class activities that incorporated laptops and believed that enjoyment translated into improved learning. One student explained, "Some kids actually want to come to school because it gives you something to look forward to. It's better than pencil and paper all the time."

Immersion increased students' technology skills. Principals, teachers, and students at nearly all campuses said technology immersion had a positive effect on students' technical skills. Educators were impressed by students' effortless use of technology resources and said that students frequently mentored or assisted teachers when they encountered difficulty using laptops. Sixth graders believed their increased opportunities to learn and practice with technology had improved their skills in areas such as creating folders, saving their work, doing research, and using programs. Additionally, some students said using laptops allowed them to improve their keyboarding skills and become better typists.

Immersion provided students with greater access to information, new resources and learning tools, and more opportunities for self-responsibility and self-regulation. Across campuses, students expressed a preference for laptops over textbooks, noting that laptops permitted access to broader and more current information and enabled them to manage assignments more effectively. Some teachers also believed that the greater access to information offered by laptops allowed students to broaden their world views and learn more about the world outside of their hometown. This was viewed as especially important for students who attended schools located in small and rural communities.

Laptops also contained learning tools and programs that provided students with valuable resources that reshaped their approach to class work and improved their study habits. Students noted the benefits of management tools (iCal) and productivity tools (Microsoft Office and AppleWorks) for improving the nature and quality of their school work. Laptops also raised expectations for student maturity and responsibility. In the fall, many educators expressed concerns about students' ability to care for their laptops; however in the spring, teachers and principals, for the most part, were pleasantly surprised by the responsibility students demonstrated. Students also thought laptop ownership had encouraged their greater responsibility. One sixth grader declared, "I can have more responsibility with other things because I take my responsibilities with the laptop."

Although many students believed laptops made them better learners and improved their academic performance, most teachers were reluctant to link immersion to student achievement. Noteworthy differences emerged between students' and teachers' views on the effects of immersion on student achievement. Sixth graders in more than two-thirds of schools reported that laptops made them better learners and improved their academic performance. Students believed they could learn more, easier, and faster when assignments incorporated laptops. Students said laptops checked their spelling, assisted in solving math problems, provided content-related games, facilitated reviews, enhanced their research and writing, and provided individualized assistance. Teachers, on the other hand, believed that the distractions introduced by computer games, Instant Messaging, and other laptop inspired off-

task classroom behavior, undermined laptops' potential for improvements in student grades and achievement. Some teachers, however, predicted that immersion might lead to future improvements in achievement.

7. Technology Immersion—Lessons from the First Year

Findings from the first year provide direction for the refinement of the technology immersion model as well as information for other schools planning a technology immersion project. Lessons on technology immersion are organized around leadership and planning, technical support, professional development, classroom immersion, and sustainability and expansion.

Leadership and Planning

Involve district and campus leaders, teachers, and parents in the decision to become a technology immersion campus. The reliance on a competitive grant application process for selecting TIP campuses limited stakeholder involvement in decisions to become immersion campuses. Due to the restricted timeframe, districts and schools had limited opportunities for broad-based participation in planning and grant development. Consequently, about a third of middle school principals were not involved in the decision, and few teachers contributed to the decision to apply for the grants. Many teachers first learned about the TIP grant when they returned from summer break. Even though all awarded campuses should be commended for the rapid turnaround of their applications, the abbreviated timeframe for grant development contributed to subsequent challenges, including insufficient understanding of the immersion concept and lower levels of teacher buy-in for immersion. Although teacher resistance to immersion had subsided on some campuses in spring, gaining teacher commitment remained a central challenge of implementing technology immersion in the first year.

Ideally, decision making should involve the entire campus staff in building a clear understanding of technology immersion and how immersion goals for the school, classroom environments, and student-centered learning align with campus goals and teacher expectations for their own practice. Although broad-based involvement of stakeholder groups may not ensure a smooth transition to an immersion campus, it could diminish some obstacles encountered by TIP campuses in the first year. Many teachers at immersion middle schools in fall were perplexed about how technology immersion would work in their classroom, and a substantial proportion of these teachers remained unclear about or uncommitted to the immersion concept in spring.

Build strong leadership for immersion. Although leadership was not a specified technology immersion component, district and campus leaders played an important role in first-year implementation. Leadership instability at both the district and campus level was an important factor. While some leaders were intimately familiar with and involved in the project, others were newly appointed and unfamiliar. At the district level, some administrators had few campus interactions, while others were substantially involved in professional development, campus visits, and ongoing communication with campus leaders. Principals demonstrated leadership in a number of ways. Strong campus leaders appeared to schedule planning time for immersion, communicate expectations, model technology use, marshal necessary resources, establish and enforce student policies, and encourage teachers' initial efforts at immersion.

Allow extended time to plan for immersion. Comprehensive planning is considered an essential first step in creating an immersion school, and some believe this may take a year or more (Zucker, 2005). Unfortunately, the timing of the TIP grants (awards in May or July and start-up in August) left little planning time prior to implementation. District representatives, understandably, reported problems

with the timing of grant notification and implementation. In particular, teachers could not prepare or receive training over the summer. This was especially important, because according to campus technology coordinators, many teachers at immersion campuses had limited technology proficiency and little experience with educational technology. Scheduling time for professional development remained a challenge throughout the first year. It is possible that additional pre-implementation planning time might have alleviated some of the first-year problems districts and campuses faced.

Establish supportive and dependable relationships with vendor partners. Because of the important role that vendors played in the delivery of hardware, software, and professional development, it was critically important to establish a close relationship with vendors early in the planning phase. In the first year, effective vendor relationships appeared to advance campuses efforts with technology immersion, whereas difficulties in communicating with vendor partners undermined the potential for accessing needed technical and other support services.

Devise a plan for dealing with complex logistical arrangements. Many TIP districts and campuses were unprepared to deal with the myriad logistical issues that surfaced as an early part of immersion. The process of laptop acquisition, setup, and program installation was challenging. Common logistical problems included distribution and collection of laptops, laptop storage, charging batteries, daily maintenance processes, and hardware and software issues. For some districts, the size of the project (e.g., a district with 1,400 students involved in TIP) created additional logistical challenges. Generally, district representatives felt confident of improvement in the coming year due in part to the experience they gained in distributing and caring for laptops in the first year. One district representative said, "We've learned a lot from this year. I think we're ready to move forward."

Ensure laptop and Internet security. One of the most prevalent challenges described by TIP grantees related to security issues. These included the security of the laptops (damage and theft) as well as access to inappropriate websites and student misuse. One district representative summarized the challenges:

> If we could have put security measures in the grant beforehand, if the grant would have required us to identify, "What steps are you going to take to ensure student security from Internet predators, what steps are you going to take to ensure physical security of the equipment, and what steps for long-term storage," that would have helped us think through those processes.

Districts and middle schools used a variety of approaches to prevent loss of and damage to laptops, such as using local funds to pay for insurance, purchasing geographic tracing software, and requiring parents to insurance fees.

Although districts typically installed Internet filtering systems to block student access to inappropriate websites, Internet security remained a challenge throughout the first year. In some instances, there were challenges because the filtering software did not work properly. For instance, a district representative explained, "The only problem was that it worked so well it blocked many things; even the resources that they [teachers and students] were supposed to use they couldn't get to." Additionally, some students were able to access inappropriate sites when they used their laptops outside of the school.

In addition to Internet security, campuses dealt with issues such as students' inappropriate access to email and instant messaging. Monitoring students' laptop activities was another challenge. In at least two districts, technicians installed software to prevent students from being able to erase their laptop's history. A district representative explained:

> That is one of those things you learn as you go. Kids are so smart. The second a kid got in trouble because a teacher could go and check the history of what sites they were on; within a day they had taught themselves how to erase their histories. Part of me is like that is really not good, but part of me is amazed by their problem-solving strategy.

Establish well-defined and understood policies and practices relative to student responsibility and appropriate use, and parent oversight. As suggested above, the provision of individual laptops for middle school students creates a school culture that demands greater student maturity and self-responsibility than previously has been required. Students must learn to care for valuable equipment, use laptops appropriately at school and at home, and make appropriate behavioral decisions. Although many administrators and teachers were pleasantly surprised by the responsibility students demonstrated in the first year, laptop misuse was a problem for some students. Almost all principals reported that their schools had to revise policies to more clearly articulate behavior expectations for both students and parents. Moreover, after updating policies, many principals believed that it was critically important to communicate laptop and Internet access responsibilities and expectations to parents through presentations, training sessions, and letters. Training for students on appropriate laptop and Internet use, prior to receiving the laptops, was another essential element of immersion.

Budget for additional funds beyond the grant award. Several districts in the first year struggled with insufficient grant funds and hidden implementation costs Representatives from two districts shared their frustrations:

> We barely had enough money to do what we needed to do. We don't have any money for contingencies. We don't have any money for spare computers, and we have just enough for that campus…but, as I said, we didn't have enough to fund a 1,000-student campus without putting additional district funds in.

> We've spent approximately $100,000 in local money for associated supplies and equipment…Of course, we needed the local funds to hire the technician, to pay for the insurance…There are just lots of associated expenses.

Technical Support

Build a healthy infrastructure for wireless technology prior to immersion. An inadequate school infrastructure for technology plagued some districts and campuses. Many district and campus leaders said antiquated middle schools did not have the necessary technical capacity to support immersion. Leaders described problems with electrical capacity, struggles to install a wireless network with an adequate number of access points, and network limitations, including poor Internet connections, which frustrated their efforts at immersion. One district representative explained how they hoped to improve the network at one of their schools:

> Probably our most critical issue is the network at [school name]…We don't have a network in place that handles that [wireless], and we knew that. So here you're not only talking about network upgrades, wiring closet upgrades, switches, all of that…We have put some more grounds in place.

Hire campus-based technical support for immersion, and ensure that staff members have dedicated time for their assigned duties. As early as fall, campuses recognized that a shortage of well-trained technical staff was an obstacle to technology immersion. Technology coordinators, especially at small campuses, realized that the increased demands of immersion would over-extend technical staff members who were already spread thin. As expected, the level of technical support varied widely during first-year implementation. Many campus coordinators did not have the requisite backgrounds to

provide broad-based technical support. Moreover, many campus technology coordinators were expected to spend time supporting teachers' efforts at classroom immersion, but the technical demands of immersion left little time for campus coordinators to support teachers' lessons with technology. Thus, teachers most often relied on each other for pedagogical support. While teacher collaboration was desirable, many of these teachers were ill-prepared to offer expert advice on classroom immersion.

Professional Development

Provide a well-defined and consistent model for professional development. One goal of the Request for Qualifications for technology immersion packages was the promotion of similar professional development models across TIP campuses. However, in the first year, the nature of professional development varied by vendor providers (Apple, Dell/Co-Nect, and Region 1 ESC) as well as by each campus's support for the vendor's efforts. All told, the lack of a consistent model for professional development across vendors and campuses meant that teachers received varying degrees of training depending on their vendor, and in some cases, depending upon the individual assigned as the primary trainer for their campus. Teachers in some schools reported receiving extensive training in package tools and methods for integrating laptops into instruction, while other teachers said they received cursory training in package resources and little or no training in classroom integration. There also were wide variations in the level of classroom-based mentoring or coaching provided during the first year. On some campuses, teachers said trainers observed them teach and provided constructive feedback or modeled lessons using technology. On other campuses, classroom support was limited to brief visits in which trainers asked teachers about the problems they encountered or suggested online resources specific to the teacher's subject.

The variations in the characteristics of vendor-provided professional development suggest that teacher outcomes also may vary across campuses. Teachers receiving more in-depth training coupled with classroom mentoring and modeling may be better equipped to plan and implement technology integrated lessons than teachers who received less extensive professional development.

Address both knowledge of immersion resources and classroom integration. According to many teachers, first-year professional development activities focused on the use of package tools and the identification of online resources with little attention to planning integrated lessons and techniques for integrating laptops into instruction. Not surprisingly, most teachers described nominal changes in their classroom practice as a result of professional development. Teachers said they were successfully integrating their lessons because they used PowerPoint and LCD projectors to present their lessons, directed students to online resources, and identified games that aligned with their course content. Few teachers described using laptops for student-centered instruction, project-based learning, or other in-depth, inquiry-based activities.

Provide distributed training with time for classroom implementation. Many teachers said that they had difficulty retaining training content because large amounts of material were presented at one sitting, training content was too advanced, the pace of training was too rushed, or because they had little opportunity to use what they had learned in a timely fashion. Teachers suggested that shorter trainings focused on a single skill or program that had immediate applications to classroom instruction would be more useful than longer trainings covering a variety of applications. Teachers said that trainers needed to be cognizant of varying skill levels among teachers and to group teachers according to ability. Some teachers also asked for written materials to accompany training in package resources. Teachers said that written materials would enable them to refresh their knowledge of package tools without relying on trainers.

Explore ways to address professional development scheduling challenges. The extensive professional development provided with TIP grants challenged school administrators to balance teachers' need for training with the amount of time spent out of the classroom. Concerns over lost class time and the expense of substitutes caused some administrators to schedule professional development activities during teachers' planning periods and during the summer months. Many teachers who participated in conference period activities said that the format was too short and too rushed for them to gain much from the training. However, teachers on smaller campuses, where only one or two teachers attended training during each conference period, appreciated the format because it enabled more individualized instruction. In addition, administrators sought to limit the amount of professional development provided in the months preceding TAKS testing, and several principals said they did not permit trainers to visit campuses as test preparation intensified.

Some principals sought to schedule professional development during the summer, but summer training schedules were not well received by teachers who felt the plans intruded on their summer holidays. Some district representatives also expressed concern about adding tasks or training to the teachers' already full schedule.

Provide teachers with time, guidance, and support for change. Across campuses, teachers said that professional development activities and subsequent attempts to apply what they had learned to their classroom practice absorbed a great deal of time. Teachers said that the greatest benefit of first-year professional development was increased comfort using computers in the classroom and that they looked forward to greater gains in the subsequent school year. Teachers who described the greatest changes during first-year implementation taught on campuses with strong administrative support for immersion. These teachers said that administrators expected them to incorporate laptops into instruction but were not critical of their attempts at integration. Administrators also supported classroom integration by limiting disciplinary confiscations of student laptops, which reduced the number of students without laptops available for class activities.

Classroom Immersion

Recognize that teachers in the initial stages of immersion will generally use laptops and digital resources to enhance their existing instructional practices. Baseline data for fall showed that many teachers at immersion campuses were using Microsoft Office (or AppleWorks) products to report grades and attendance, and in some cases, to submit lesson plans. Many teachers also used their classroom computers to access the Internet for lessons, and they used a variety of educational software programs (e.g., Accelerated Reader), either in their classrooms or computer labs, to support students' basic skills in core-content areas. Classroom use trends for spring showed that one-to-one student access to laptops increased the frequency of students' classroom technology use, but the kinds of technology use remained much the same. Immersion teachers most frequently had students search the Internet for information on a particular topic as part of class work, and they often had students use the laptops' word processors for reports, papers, journals, and other written products. The use of presentation software (PowerPoint or Keynote) and various kinds of educational programs was also prevalent. These finding are consistent with other research on teachers' adoption of classroom technology. As a whole, teachers in the first year were at the "adaptation" stage. That is, they were adapting traditional teaching strategies to incorporate more productivity tools, such as word processors for student writing and Internet research (Sanholtz, Ringstaff, & Dwyer, 1997; Texas Teacher StaR Chart, 2005).

Assess teachers' existing technology knowledge and skills and plan accordingly. Classroom immersion was a substantial challenge for teachers who began the year with limited technology knowledge and skills. School principals, technology coordinators, and teachers themselves worried

about immersion teachers' low levels of technology proficiency in fall. Many recognized that professional development and ongoing support would be essential to advance one-to-one laptop access. At the onset, many teachers also were uncertain about the immersion concept and concerned about the increased work load. Given teachers' initial readiness for immersion, it was not surprising that the level of classroom implementation varied widely in spring. While nearly all teachers reported that they integrated laptops into their lessons at least some of the time, students saw vast teacher-to-teacher differences. Students said some teachers "hardly ever" used laptops whereas other teachers used laptops "a lot" or "every day." Consequently, students' classroom experiences with technology in the first year depended upon their assigned teachers.

District representatives also noted classroom-to-classroom inconsistencies and hoped to achieve more uniform classroom implementation and stronger integration in the second year. For example, one district representative was pleased that "the teachers will have the summer to be thinking about how they can incorporate more technology into their lessons." Another district representative explained,

> I would say our second biggest challenge is consistency of implementation. I have got pockets of excellence right now. I can walk you around [school names] and show you 10, 20 good teachers that are using technology every day expertly, and I would show them off and model them, and they are wonderful. And then I've got 10 to 20 that are on each campus that are trying and struggling a little bit but trying. And then I've got 10 to 20 that I need to bring along. So I want a consistency of expertise out there.

Consider a gradual approach to the introduction of instructional and assessment resources. Teachers and students received a wealth of instructional and learning tools as part of the TIP packages. Unfortunately, in the first year, teachers reported limited use of the instructional resources, except for the productivity tools with which they were already familiar (e.g, Word, PowerPoint, Keynote). Similarly, few teachers used the online assessments. Teachers cited numerous barriers to resource use, including insufficient training, technical glitches, limited time, opinions of poor product quality, and a perceived lack of alignment with subject-area standards and TAKS objectives. Because licenses for instructional and assessment resources are quite expensive, greater efficiency may be gained by seeking school and teacher input on the kinds of resources that best support the core-content areas, gradually introducing those resources, and providing training that directly supports curricular integration.

Sustainability

Plan for continuation as part of the decision to become a technology immersion district or campus. By the end of the first year, district and campus leaders realized that they faced issues with continuing the implementation of technology immersion into the next year and beyond. District representatives described concerns about the transfer of laptops and how they would need to purchase new ones either because of damage or increased student enrollment. The director of technology at one district explained, "Probably, the concern—and I don't know to what extent we're going to have to face this—is if we do have more students come in, if we're short equipment, how are we going to address that?"

Half of district representatives shared concerns about funding in the upcoming years. They wondered about their ability to continue implementation, given budget limitations. For instance, one district representative reported, **"**The major problem and challenge is going to be money. This is an expensive project; we are only able to do it because we have a grant. Similarly, other district personnel wondered what would happen after the grant ends:

> Next year we'll still have money [for e-chalk] and we'll have the other things that are available to them [netTrekker]. And they use those things. Now, those are things that cost, and

> so to continue that cost, and so to continue to use them…I just think it would be a shame for them to finally get used to integrating all of these things into the lessons and become comfortable with it and then it's taken away from them. So that is of some concern.

Others hoped to upgrade hardware and software or continue technology training in the upcoming year of implementation. For example, one district wanted to buy "white boards," while another district purchased a web-based software system with licenses for all teachers.

More than half of the principals said that technology immersion will remain important on their campuses after the grant ends. A few principals indicated they were planning to identify other sources of revenue for supporting technology in the future. Some technology coordinators worried about the grant's sustainability beyond the funding period, noting that once TIP funding ended, hardware would become obsolete fairly rapidly. One coordinator explained:

> I'm worried that it won't continue after the three years, because if we don't get another grant and the laptops become obsolete or we don't have the money to upgrade, then are we going to end up in the graveyard again like most projects end up? And I don't want to see that happen. I'm hoping that this will perpetuate in some way that it continues from here.

Expansion

Consider how immersion may need to be expanded to other schools and students. Immersing some but not all campuses in a district raised new issues about equitable technology access. About half of district representatives wanted to expand TIP to serve other schools and students. One of the major concerns, which district personnel described, was how to deal with the fact that middle-school students would lose their laptops after eighth grade as they moved to high school. Specifically, many were concerned about limited availability of technology at the high schools. One district representative lamented, "I wish we'd thought about, for eighth graders who are going to ninth grade, they're not going to have a laptop, and I wish we'd have thought about sustainability into the high school."

More than half of district representatives blamed financial limitations as the major barrier to expanding immersion to other students, grade levels, or schools. One district, however, did plan to expand the program to the high school level. A representative described plans, "It's been so successful we're trying to extend it to our high school because of something we've got started with these eighth graders. We don't want to take away from them and move them backwards."

References

Becker, H. J. (1999). *Internet use by teachers: Conditions of professional use and teacher-directed student use*. Retrieved from http://www.crito.uci.edu/TLC/findings/internet-use/report.htm.

CEO Forum on Education and Technology (2001). *Key building blocks for student achievement in the 21st century: Assessment, alignment, accountability, access, analysis*. Washington, DC.

Fullan , M. (1999). *Change forces: The sequel.* Philadelphia, PA: Falmer Press

Ringstaff, C. & Kelley, L. (2002). *The learning return on our educational technology investment.* WestEd. Retrieved from www.wested.org/cs/wes/view/rs/619.

Rosenholtz, S. (1989). *Teacher's workplace: The social organization of schools*. New York: Longman.

Sandhotz, J., Ringstaff, C., & Dwyer, D. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press.

Shapley, K.S., Benner, A.D., Heikes, E.J., & Pieper, A.M. (2002). *Technology Integration in Education (TIE) initiative: Statewide survey report, Executive Summary.* Austin, TX: Texas Center for Educational Research.

Spillane, J. (2003). Educational leadership. *Educational Evaluation and Policy Analysis, 25(4),* 343-346.

Texas Education Agency (2000*). Progress report on the Texas Long-Range Plan for Technology, 1996-2010.* Austin, TX: Texas Education Agency.

Texas Education Agency (2002*). 2002 Update to the long-range plan for technology, 1996-2010: A report to the 78th Texas Legislature from the Texas Educational Agency*. Austin, TX: Texas Education Agency.

Texas Education Agency (2004-05). *Texas Teacher STaR Chart*. Austin, TX: Texas Education Agency, Educational Technology Unit, Division of Curriculum.

Zucker, A., & McGee, R. (2005, February). A study of one-to-one computer use in mathematics and science instruction at the secondary level in Henrico County Public Schools. SRI International. SRI Project P12269.

Appendix A

Technology Immersion Evaluation Design

The evaluation design is quasi-experimental with a carefully matched comparison group. The design aims to approximate a randomly assigned control group by matching immersion schools with non-immersion schools possessing similar pre-program characteristics. For this study, interested districts and associated middle schools responded to a Request for Application (RFA) offered by the Texas Education Agency (TEA) in spring 2004 to become technology immersion schools. Applicants to become Technology Immersion Pilot (TIP) sites had to meet eligibility requirements for Title II, Part D funds (i.e., high-need due to children from families with incomes below the poverty line, schools identified for improvement, or schools with substantial need for technology).

Twenty-two technology immersion schools, selected through the competitive grant process, were matched by researchers with 22 control schools on key characteristics, including size, regional location, demographics, and student achievement. The TIP grants targeted high-need schools, thus nearly 70% of students in the study come from economically disadvantaged backgrounds, with many schools in rural or isolated locations. Students are ethnically diverse, roughly 56% Hispanic and 9% African American.

The evaluation originally aimed for an experimental design with random assignment of 60 schools to treatment (n=30) and control (n=30) groups. Unfortunately, the recruitment of districts and related middle schools proved to be a major obstacle to the random assignment of schools due to funding restrictions (Title II, Part D) and the amount of available dollars ($14 million).[1]

Treatment Sample

In January 2004, the TEA released a RFA for school districts to receive TIP grants for up to two middle schools. During this initial round, only 14 eligible districts applied—of these, 11 were small districts with one middle school campus, and 3 were larger districts with multiple middle schools. The majority of applicants had 300 or fewer students at their campus. The TEA held an external review of proposals in early May. Applications were scored by five readers and scores were rank ordered. Following the external review, researchers and agency staff reviewed proposals to ensure that applications met the criteria established for technology immersion.

At this point, researchers knew that a second round of applications would be necessary, so first-round choices concentrated on the selection of small schools for the treatment sample. In the selection process, researchers considered factors such as (a) RFA rating scores, (b) district and campus size—small, mid-size, and large, (c) regional location (i.e., Education Service Center region), (d) the proportion of economically disadvantaged and minority students, and (e) the percentage of students passing TAKS (all tests). Five small middle schools (300 or fewer students) and one large middle school (900 students) were chosen in the first round of RFAs.

To increase the pool of middle schools for the evaluation study, a second RFA for TIP grants (Round 2) was released in late May 2004. Additional recruitment efforts were undertaken through phone, email, mailings, and a videoconference for potential TIP grant applicants. In an effort to attract larger districts and middle schools, the RFA funding formula was modified to increase the amount of

[1] It was anticipated that grants would be awarded in amounts up to $350,000 to support technology immersion in grades 6 through 8 middle schools. State-level statistics revealed an available pool of 486 middle schools.

grant funds. The amount awarded to a participating campus was tied to campus enrollment: 350 students or less (up to $350,000), 351-600 students (up to $600,000), and greater than 600 students ($750,000). Non-funded applicants from Round 1 also were eligible to reapply and all but two districts did so.

During the second round, 22 eligible schools applied. Comparable to Round 1, expert reviewers rated the 22 proposals, and 19 proposals with a score 85 or above were eligible for selection. The selection process for treatment schools mirrored the first round. Researchers considered proposal ratings, size, location, student diversity, and academic achievement. Decisions were strongly influenced by the need for geographic distribution and the availability of comparable schools for the control group pool. Of the 19 proposals, 16 middle schools were selected for the treatment group (immersion campuses). The 3 non-selected campuses became part of the pool of middle schools available for the control group. These campuses had proposal scores comparable to selected campuses (at least 85 points)—however, they were not selected due to other considerations (i.e., geographic location and invoking a two-campus limit per district).

Of the 22 treatment schools, 14 are in small, single middle school districts (enrolling less than 3,000 students), 7 are schools in large districts (enrolling 10,000 or more students and having multiple middle schools), and 1 is a campus charter school in a large urban district (with more than 200,000 students). In sum, the originally envisioned random assignment of schools to experimental and control groups was not possible since the applicant pool did not include enough schools. Instead, researchers have used a matched control group research design, with experimental and control group campuses matched on key demographic and achievement variables. The sample size is considered adequate to detect a small effect size (.25 or larger; Cohen, 1988).

Control Sample

The selection of control campuses involved several steps. First, in order to increase the available pool of middle schools that would be eligible to receive federal funds for participation in the study, researchers generated a pool of eligible grades 6-8 campuses from a list of districts that had previously received TARGET grants (Technology Applications Readiness Grants for Empowering Texas), competitive grants funded with Title II, Part D funds. Thus, the control pool now included 251 middle school campuses in districts receiving TARGET funds and 6 schools that had applied for and earned proposal rating scores that qualified them for TIP funds (3 each in the two rounds). Of these campuses, 63 had 600 or fewer students and 194 had 601 or more.

As a next step, researchers identified middle schools that matched treatment campuses as nearly as possible on factors, including (a) district and campus size, (b) regional location, (c) the proportion of economically disadvantaged and minority students, (d) percentage of students passing all TAKS tests, and (e) the gaps between the percentage of White students and African American and Hispanic students passing TAKS (all tests). Selection involved the use of *SPSS* statistical procedures to establish parameters around each variable of interest and the creation of a computer-generated list of "best matches" for each treatment school. In addition, grant specifications required large districts with multiple middle schools to provide access to control campuses within their own district, assuming a comparable school was available, so these schools were added to the list.

The final selection process for the control group involved a review of the matched list by a team of six researchers to identify the optimal control school for each treatment school. Additional schools were selected as alternates in the case that a selected control site declined the invitation to participate in the study. This selection process yielded 22 control group schools including controls for 8 campuses that came from within the same districts as the treatment schools and controls for 14 campuses from

closely matched single, middle school districts. Similar to the experimental group, the 22 control schools included 13 in small, single middle school districts (enrolling less than 3,000 students), 8 schools in large districts (enrolling 10,000 or more students and having multiple middle schools), and 1 campus charter school in a large urban district (with more than 200,000 students). Each control school received $50,000 for study participation, with 25% of funds earmarked for professional development as required by Title II, Part D guidelines.

Appendix B

Characteristics of Technology

Table B.1. Characteristics of Technology Immersion and Matched Control Schools

	Location			Students							
Campus	District	District Enroll-ment	Community Type	Grades 6, 7, 8 Number	White (%)	African American (%)	Hispanic (%)	ESL (%)	Special Ed (%)	Eco Disadv (%)	Mobility (%)
Immersion											
Fruitvale Middle	Fruitvale	448	Rural	100	93.0	1.0	6.0	1.0	29.0	62.0	14.6
McLeod Middle	McLeod	478	Rural	138	93.5	4.3	1.4	0.0	17.4	44.2	14.6
Monte Alto Middle	Monte Alto	501	Rural	151	4.0	0.0	96.0	19.2	13.9	90.1	14.3
De La Paz Middle	Riviera	511	Rural	123	35.0	0.8	63.4	6.5	17.1	62.6	12.9
Charlotte Junior High	Charlotte	514	Rural	118	16.9	0.0	83.1	1.7	17.8	66.1	12.0
Memphis Middle	Memphis	530	Rural	124	46.8	12.9	40.3	12.9	19.4	65.3	14.6
Morton Junior High	Morton	540	Rural	117	23.9	11.1	64.1	5.1	9.4	78.6	12.2
Post Middle	Post	986	Non-metro: Stable	207	45.4	6.8	46.9	0.0	14.5	56.5	27.1
Floydada Junior High	Floydada	1,041	Non-metro: Stable	240	32.5	4.2	63.3	11.3	10.8	63.3	15.1
Newton Middle	Newton	1,307	Non-metro: Stable	299	53.8	41.8	2.0	0.3	18.1	57.9	18.8
Dublin Middle	Dublin	1,331	Non-metro: Stable	309	53.7	0.3	45.3	5.2	12.6	64.4	17.2
Brady Middle	Brady	1,385	Non-metro: Stable	295	54.9	3.1	41	1.4	19.3	62.0	14.5
Franco Middle	Presidio	1,516	Non-metro: Stable	341	0.6	0.0	99.1	38.1	10.6	93.5	15.0
Bernarda Junior High	San Diego	1,542	Non-metro: Stable	354	1.1	0.3	98.6	11.9	13.8	82.5	11.5
Wilson Middle	Port Arthur	10,356	Central city sub.	795	2.3	70.7	19.1	0.0	11.4	83.3	14.0
Austin Middle	Bryan	14,104	Central city	962	32.7	19.4	47.1	6.1	12.4	65.0	21.7
Woodland Acres Middle	Galena Park	20,388	Major suburban	416	7.2	7.0	85.8	22.8	11.1	85.6	12.0
Cigarroa Middle	Laredo	24,359	Central city	1,447	0.3	0.1	99.6	57.3	18.9	99.4	17.1
Memorial Middle	Laredo	24,359	Central city	713	0.7	0.0	99.3	51.6	19.1	97.5	20.1
Baker Middle	Corpus Christi	39,185	Central city	861	21.7	2.2	71.8	0.8	9.5	49.0	17.9
Cullen Middle	Corpus Christi	39,185	Central city	448	37.1	1.3	61.4	0.9	13.2	44.9	23.0
Kaleidoscope (Charter)	Houston	211,157	Major urban	110	0.9	6.4	90.9	30.0	1.8	96.4	6.1
Immersion school means				**394**	**29.9**	**8.8**	**60.3**	**12.9**	**14.6**	**71.3**	**15.7**

Table B.1. Characteristics of Technology Immersion and Matched Control Schools (Continued)

	Location			Students							
Campus	District	District Enroll-ment	Community Type[a]	Grades 6, 7, 8 Number	White (%)	African American (%)	Hispanic (%)	ESL (%)	Special Ed (%)	Eco Disadv (%)	Mobility (%)
Control											
Ore City Middle	Ore City	817	Non-metro: Stable	203	85.2	6.9	7.9	0.5	18.2	50.7	19.9
Harleton Junior High	Harleton	624	Rural	155	97.4	2.6	0.0	0.0	12.3	25.2	15.9
Hamlin Middle	Hamlin	522	Rural	106	54.7	6.6	37.7	0.0	23.6	65.1	22.0
O'Donnell Junior High	O'Donnell	373	Rural	83	44.6	0.0	55.4	0.0	18.1	67.5	17.3
Odem Junior High	Odem-Edroy	1,175	Non-metro: Stable	287	19.5	0.0	80.1	2.8	11.5	53.3	11.3
Wellington Junior High	Wellington	555	Rural	141	55.3	7.1	37.6	7.8	16.3	62.4	12.2
Seagraves Junior High	Seagraves	589	Rural	142	26.1	11.3	61.3	2.8	21.1	63.4	6.5
Skidmore-Tynan Jr. Hi.	Skidmore-Tynan	713	Rural	176	35.8	0.6	63.6	1.7	16.5	60.2	18.8
Slaton Junior High	Slaton	1,382	Non-metro: Stable	335	36.1	8.7	54.9	2.1	12.5	61.5	18.6
Timpson Middle	Timpson	568	Rural	140	65.7	29.3	4.3	2.1	12.1	60.7	18.6
Cameron Junior High	Cameron	1,638	Non-metro: Stable	372	43.5	19.9	36.3	1.3	11.8	63.2	11.0
Coleman Junior High	Coleman	1,025	Non-metro: Stable	248	71.8	1.6	25.8	0.0	13.3	54.0	22.3
Truman Middle	Edgewood	12,873	Major suburban	482	0.2	0.2	99.6	10.6	21.2	96.9	25.3
Newman Middle	Cotulla	1,264	Central city sub.	281	8.5	0.0	91.5	14.2	13.5	82.9	13.9
Austin Middle	Port Arthur	10,356	Central city sub.	503	16.7	58.8	19.1	0.0	3.2	67.4	25.0
Rayburn Middle	Bryan	14,104	Central city	1,190	51.4	27.1	20.8	2.4	11.1	47.6	16.2
Galena Park Middle	Galena Park	20,388	Major suburban	1,009	5.0	8.5	86.4	15.5	13.8	78.3	12.7
Lamar Middle	Laredo	24,359	Central city	1,390	1.3	0.2	98.1	26.6	17.7	90.1	14.8
Faulk Middle	Brownsville	48,857	Central city	888	0.8	0.0	99.2	37.6	19.3	99.1	18.0
Hamlin Middle	Corpus Christi	39,185	Central city	805	25.8	3.7	69.9	1.1	17.4	56.5	19.3
Haas Middle	Corpus Christi	39,185	Central city	476	65.4	6.5	59.5	0.6	18.9	50.6	26.4
Briarmeadow (Charter)	Houston	211,157	Major urban	89	48.3	15.7	32.6	3.4	12.4	29.2	1.5
Control school means				**432**	**37.6**	**9.8**	**51.9**	**6.1**	**15.3**	**63.0**	**16.7**
Immersion school means				**394**	**29.9**	**8.8**	**60.3**	**12.9**	**14.6**	**71.3**	**15.7**
Overall school means				**413**	**33.7**	**9.3**	**56.1**	**9.5**	**14.9**	**67.2**	**16.2**

Source. Texas Education Agency AEIS reports 2004.

[a] Community Type: Major urban (six largest districts in the state), Major suburban (other school districts in and around major urban areas), Central city (largest districts in other large, but not major, Texas cities), Central city suburban (school districts in and around the other large, but not major, Texas cities), Independent town (largest districts in counties with 25,000 to 100,000), Non-metro: Fast growing (school districts smaller than other categories, exceed state median, and have 5-year growth rate of 20%), Non-metro: Stable (school districts smaller than other categories, exceed state median, and have stable growth), Rural (number of students is between 300 and the state median or less than 300).

Appendix C

Technology Use in Core Subjects

English Language Arts and Reading

In English language arts and reading classes, students' laptops most commonly provided a tool for acquiring factual knowledge or creating written products.

Learn basic factual information. Students at more than half of the schools (13) cited ways that their teachers used laptop computers in English language arts or reading classes to improve their basic knowledge and skills in areas such as grammar, spelling, and vocabulary. Sixth graders in two schools described the use of interactive workbooks to practice grammar skills. In other schools, students visited websites to complete grammar exercises involving the identification of misspelled words, misplaced commas and periods, or parts of speech (e.g., online English textbook, English.com, and LanguageArts.com).

In other schools, students used productivity software or games for skill practice. For example, one teacher used Microsoft Publisher to teach the parts of speech. A sixth grader explained, "We're doing a newsletter on verbs, adjectives, nouns, proper nouns." Although students usually used the textbook, they believed technology made grammar more fun because they could write their own sentences and use Clipart for illustrations. A student in one school described how the Paint program was used to create synonym or antonym webs.

Sixth graders also used their laptops to study spelling words, with assistance from electronic resources such as the World Book, dictionary, or spellchecker. One student explained, "We have spelling words once a week. Every Monday, we're taught the words, and we find the definitions in World Book." In other schools, students used PowerPoint to write spelling words and definitions or found synonyms and pictures for spelling words in an online dictionary. Other students said they used their word processor's "spellchecker" to check for and correct spelling errors.

Laptops also provided a tool for vocabulary study. Students in several schools reported that they used their laptop's dictionaries or the Internet to type definitions for vocabulary words. Students in one school explained, "For reading, if we have to look up definitions, we can look them up on the Internet"…"And for English…we get a worksheet of a whole bunch of definitions, and we have to make a story out of those definitions on a Word document."

Write papers, compositions, or reports. Students in about half of immersion schools (12) said they used their laptops for writing papers, compositions, or reports. Most teachers reported that they had their students use Microsoft Word to type their assignments. Assignments typically involved Internet research on a topic accompanied by the use of a word processor to create a written product or presentation software, such as PowerPoint or Keynote, to develop a presentation. A student in one school summed up the value of laptops for writing this way:

> Like before, we just wrote it on paper, but now they give us more ideas. You go to a certain website. There's a design on that website, and it's like you have to include other stuff in your writing, like pictures from the Internet and stuff, and it just makes it more fun to write papers.

Students conducted Internet research for reports on topics such as homing pigeons, commercials, favorite foods, sports history, and falconry. One student explained: "We did a research project on

favorite types of commercials, and we had to go in there and find different commercials for each type." Several teachers reported assigning Internet research projects about famous authors and novels. Students in three middle schools described auto-biographical projects. Sixth graders in one school completed a project in English language arts called "All about me." The project involved scanning pictures for each student into the computer and making a movie using MovieMaker. Other students told about their BioPoint:

> It is about ourselves, how we are. It is called a BioPoint, and we do it in a Microsoft PowerPoint. We just write and we get pictures from Clipart and the Internet so we paste them into Microsoft PowerPoint and just describe ourselves, how we are.

In some instances, students described how they researched a topic, prepared a report, and developed a presentation. One explained, "We've been doing PowerPoints on propaganda. We've done a report; it took a lot of our time, and we used our laptops for the Internet searches." A different student described research and the creation of a PowerPoint presentation on "genetic diseases."

Compose journal entries. In several schools (7), students used word processors in English language arts classes to type personal journal entries on a daily or intermittent basis. A student in one class said, "We go there everyday, and there's a journal topic on the board, and we talk about it." At another school, students explained, "We write about what we feel...Where you make a journal, and there's a subject, and we have to write about it."

Study poetry. Students at a few schools (4) used laptops to write poems. "We had to do a poet study project," said one student, "and it was really hard. We had to find stuff on our poets and pictures and stuff…and some of the things on the poets weren't even on the computer."

Read stories and books. In two schools, students read stories on their laptops and answered related questions. In two other middle schools, laptops provided access to background information that enriched reading comprehension. For example, students searched for information about particular scientists, authors, birds, or animal habitats mentioned in their reading material. Students in another school "highlighted" important words in electronic reading selections. Software programs enriched reading at four other schools. For example, students used Inspiration software to make a web or timeline related to a reading selection, used a word processor to write a letter after reading a book, or used publishing software to create a brochure.

In two schools, students said they used a word processor to type book reports or PowerPoint to make a presentation and share a book they had read. Students in two other middle schools described the use of KidBiz in their English language arts classes. One student explained, "Sometimes we go on KidBiz and we do a story…You can do a story of the day and you can answer the questions on it."

Take or prepare for tests. At three schools, students reported using their laptops for tests on English language arts topics or for TAKS practice. One student explained, "We did a TAKS test online for reading." A different student said, "We take like online pretests…It's kind of like TAKS, but it's on the computer…And it helps us practice." In a different school, students described the use of Study Island for reading: "It's cool because you get to play games that help you read. You can take the online test and see how you're doing."

Mathematics

Teachers at many campuses seemed to be struggling to find ways to integrate technology into the math curriculum. Teachers at about a third of schools (8) reported some use of technology in their math courses, mainly Texas Mathematics Diagnostic System (TMDS), online math games, Study Island,

Excel, and remedial online exercises for students struggling with a particular skill. However, teachers at another third of schools (7) reported that technology use in their math curriculum was limited or non-existent. The most frequently cited uses of technology in math classes are summarized below.

Take or prepare for tests. When asked about laptop use in mathematics classes, students at about half of schools (12) said they used laptops for tests or test preparation. In one school, students said, "We did like two tests on the Internet…That's all we did." In another school, students said, "We have TMDS. It's a test…to study." Sixth graders at an additional school completed online assessment activities at Study Island. In other schools, students reported using their laptops to practice for the TAKS test. One student explained, "In our math class, we can get on TAKS online tests…You can take tests to see how well we're getting at the math." Students typically enjoyed the online assessments and believed they helped them to understand math better. Students appreciated readily available "hints" for problem solving and game-like formats.

Use educational websites, programs, or games. Students in nearly a third of schools (6) mentioned occasional opportunities to use math-related websites, programs, or games. Students at one school went to AA Math to do fractions, probability, and rounding. In a different school, students described how they used Glenco Math for practice lessons with feedback:

> It teaches you easier than teachers…The laptops help me to get better grades because we go to Glenco Math, or something, and we go do lessons, and if you get it wrong, it will show the answer and how it is worked out or something like that.

Students' comments, however, suggested that these activities most often filled extra time following the completion of traditional paper and pencil assignments rather than being an integral part of planned lessons. One school was an exception to this pattern. A student explained:

> When I go in the room, she has what we're supposed to do up on the overhead, and I go to *Safari* and go to the website and get stuff for school, and then we work on stuff like that.

A student in the same school explained the use of a particular program called Gizmos: "In my math class, we go onto a website called Explore Online, and they've got Gizmos, which is, there's this little thing, you can play around with it, and then you have to answer some test questions."

Use productivity tools for math. In a few schools (4) sixth graders described ways that teachers used the laptop's productivity tools to support mathematics lessons. In one middle school, students learned how to add numbers using Excel and created a PowerPoint presentation about a shape (with a drawing and definition). These same students also used Word to illustrate a story with math terms. In other schools, students sometimes used Excel spreadsheets to create formulas, add numbers, and create graphs.

Complete math projects. Students in three schools described math projects, which had typically been assigned after the completion of the TAKS test in April. In one school, the project required students to compile financial information on the purchase of a house. For a project in another school, students received a hypothetical salary and had to keep track of their expenditures. The project in another school involved the creation of a classroom design. As students explained:

> You have to design your own classroom, and mine is a rodeo arena because I love horses. And you have to have at least two kids of electronics and the rest of it you can just design it however you want…We have a page of electronics and a page of furniture…We have I think, $20,000 to spend, and we have to spend between $19,000 and $20,000.

In general, it appeared that only a few teachers attempted project-based learning in math. Moreover, those teachers did not seem to regard more complex projects as an effective way to prepare students

for the TAKS since they did not undertake projects until after students had completed the state assessment.

Simulate a math concept. One advantage of having laptops in the math classroom is the potential for using various programs or activities to virtually simulate mathematical concepts. In the first year, only one student reported such laptop use. The student described the simulation of a math problem using a program called Math Rep. He explained: "There's this tube, and you estimate how much it is, and then you fill the other tube up with it, and you see how close it was to how much it was, and it shows the length times width."

Science

The availability of laptops in science classrooms primarily allowed teachers and students to access supplemental information on the Internet on science-related topics, use digital textbooks, define science vocabulary terms, and take tests. Teachers at two schools reported that laptops were used every day in science classes:

> Every day we always use our laptops because I told them to create a science folder for all their ISAs. And then after that, for the integration, I use the Internet…In science, there are a lot of websites that can help you with particular lessons like, there's a lesson on animation…the solar system, the cells, mitosis, model of an animal or a plant, and the pictures are good, so it helped me for enrichment.

Conduct Internet research on an assigned topic. In nearly three-fourths of schools (16), students said laptops provided a means in science class to gather more in-depth information on an assigned topic, and in many cases, to prepare reports or make presentations for classmates. At one school, sixth graders had recently completed Internet research on the food energy pyramid, with use of a Word processor for reports and PowerPoint for presentations. Students in a different school, similarly, had visited websites on topics such as the formation of planets and famous scientists (e.g., Albert Einstein) and used PowerPoint to generate presentations. Students in other schools reportedly researched and created reports or presentations on topics such as plant cells, genetics, minerals, animals, invertebrates, ecosystems, astronomy, or space colonization.

Some activities appeared to be more complex projects. For example, one student said, "We made the environment of the ecosystem and the animals that live in it and plants that live in an ecosystem." A student in a different school explained it this way:

> In science, we got like on the Internet and looked up how many animals were like in the different kingdoms and all that. Then after that, we did like this graph that showed how many animals were on each kingdom level.

Sixth graders in another school were doing a project on the Solar System. Students worked with a partner to research a planet on the Internet, explain how humans must be modified to live on the planet, and create an advertisement for potential visitors.

Access science textbooks electronically. Students at a few schools (4) said they now use digital science textbooks that are accessed either online, from a CD, or saved on their laptop. A student in one school explained:

> There are books on the Internet. Science books, particularly, on the Internet have a class file that you can type in a password so you can actually get into the books on the Internet.

Another student said, “We don’t use books anymore in science. We use a laptop. Our *iText* on our laptop” [textbook CD]. In still another school a student described how they accessed their science textbook online through “Find Your Book” in their “Favorites” list and read the textbook online.

Define science vocabulary terms. Students in a few schools (4) talked about their use of laptops to learn science vocabulary. For example, a student in one school said, “In science, we’re looking up cells, and we have to copy and paste what’s about the cells and the vocabulary.” In another school, students searched online for vocabulary definitions and pictures of the skeletal and digestive system and created a presentation with Keynote. Other students described how they copied science vocabulary words and information from their textbook on a CD, searched the Internet for pictures, and summarized the information in PowerPoint.

Take or prepare for tests. Students in four schools (4) reported the use of laptops for testing; however, unlike English language arts and math, testing in science rarely involved preparation for the state assessment (TAKS). This may reflect the fact that sixth graders do not complete a science assessment. Instead, sixth graders in one school said they used their laptops to take pretests prior to their textbook-related science tests. In another school, a student explained a different kind of review: “She [teacher] gives us like a worksheet over a video…while we’re watching a video and asks us a question on our laptops, and then we answer it while the video is going. Students in only one school said they completed TAKS review tests.

Simulate a concept or conduct an experiment. In one middle school, a student explained how they used their laptops to view the action of “tectonic plates” in science. Students in a different school recorded information on temperatures in different parts of the world in Excel spreadsheets. The small number of students and teachers mentioning simulations or inquiry suggested that such activities seldom occurred.

Do other kinds of science activities. Students in about a fourth of schools described various other kinds of laptop uses in science. In one school, students completed lessons on *KidBiz* whenever there was a story or topic relevant to science. Students in another school watched science-related videos on a special website. In a different school, sixth graders played educational games when they finished their work. In one school, students said they used their laptops to write notes in science class. Students in yet another school gathered information online to complete science worksheets.

Social Studies

In social studies classes, laptops most often served as a tool for topical research on the Internet, writing, and note-taking.

Research a topic on the Internet and generate reports, essays, or presentations. Internet research was by far the most popular use of technology in social studies classrooms. Students and teachers at nearly all schools (17) reported using laptops to access information on the Internet as an extension of topics studied in class. Students used the Internet to learn about historical periods and figures, other cultures and nations, and current events. One teacher described the value of virtual experiences this way:

> I mean the webcams with the virtual tours. They love that. With history, you need something to make it come alive. When you can use things like that it’s fun; it’s interesting.

Sixth-grade students at more than half of schools (13) said they used laptops in social studies for reports, journals, essays, or presentations. Information for these narratives typically came from Internet searches on an assigned or self-selected topic. Students cited projects relative to countries,

states and capitals, continents, famous people, and more. For example, one student explained a report on counties of the world: “My project was on Denmark, and I liked that project because they have different cultures, different foods.” In another school, a student described a similar project: “Right now in social studies, we’re looking at countries, and I have Mexico. We’re going to do a PowerPoint and a brochure.”

Sixth graders in another school were doing reports on famous European scientists. At yet another school, students were enthused about their essays on earlier time periods. One student explained the project like this:

> Right now, what we have to do is write an essay on whatever time period you pick, from like the 70s, 60s, 50s, stuff like that. And you pick one person from whatever topic you pick. Like I picked the disco era, and I picked someone from then. And you write about them, do like a mini interview. Like if they’re dead, a fake one.

Students at a different school explained how they used the Internet to get articles on current events and summarized the information. Besides information on the Internet, students in two schools said they used the World Book on their laptop to find information and do research for projects.

Take notes and answer questions. Laptops occasionally provided a medium for taking notes or answering assigned questions. Students in about a fourth of schools (6) said they mostly used their laptops in social studies classes for taking notes, or typing vocabulary words or study questions. Students in one school explained that they still use their paper textbooks, but now, “We just answer the questions on the laptops and drop them in the teacher’s drop box.” In still another school, the teacher put questions on the board, students typed the questions using Word, and then they searched for answers on the Internet.

Use social studies games or websites. In a few schools (3), students described games or activities on websites. One student said, “We use it for games…like states and capitals.” Students in another middle school went online to a site called Fun Brain to play a game on states and capitols. A sixth grader explained:

> It asks, ‘Where is Oklahoma?’—and it has a map, and you push Oklahoma, and it says, ‘No, that’s the wrong answer,’ and it shows you where it is.”

A student in a different school explained a game that allowed them to “go around the world:” “You have to scroll down to what country it was on. If it was on Brazil, you go to Brazil, and it shows you the forest, the rain forest, the animals, and everything else.

Create charts, maps, or semantic webs. Students in about a fourth of schools (5) said they used various software applications to create charts, graphs, maps, or webs for their social studies reports or projects. In one school, students used a program called Chart Creator. In two schools students used programs to draw and color maps. Other students talked about the use of Inspiration software for semantically mapping questions and answers, or mapping information on countries studied.

Review for tests. Students in two schools used laptops for test preparation or review, and similar to science, reviews involved textbook content rather than preparation for the TAKS. One student explained, “Every time we finish a section in social studies we always review it on our laptops, and we can look how big it is and how much people learn it.”